

Fig. 1a (Prior Art)

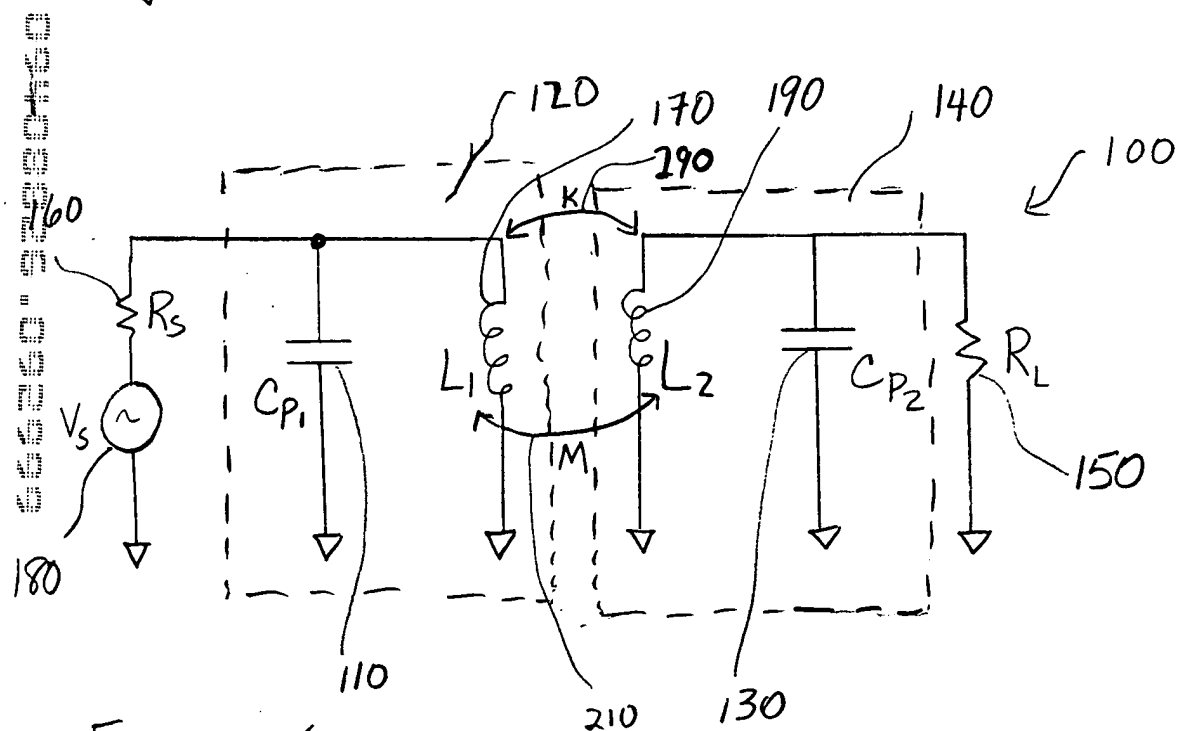


Fig. 1b (Prior Art)

400 MHz Filter Band Pass Filter
Series Double Tuned Circuit
(Prior Art)

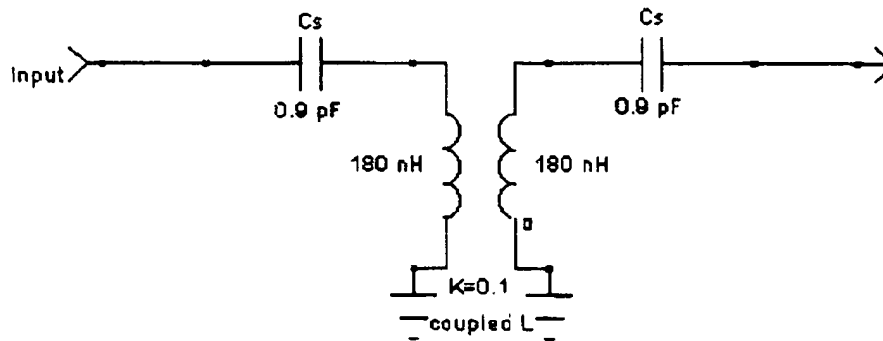
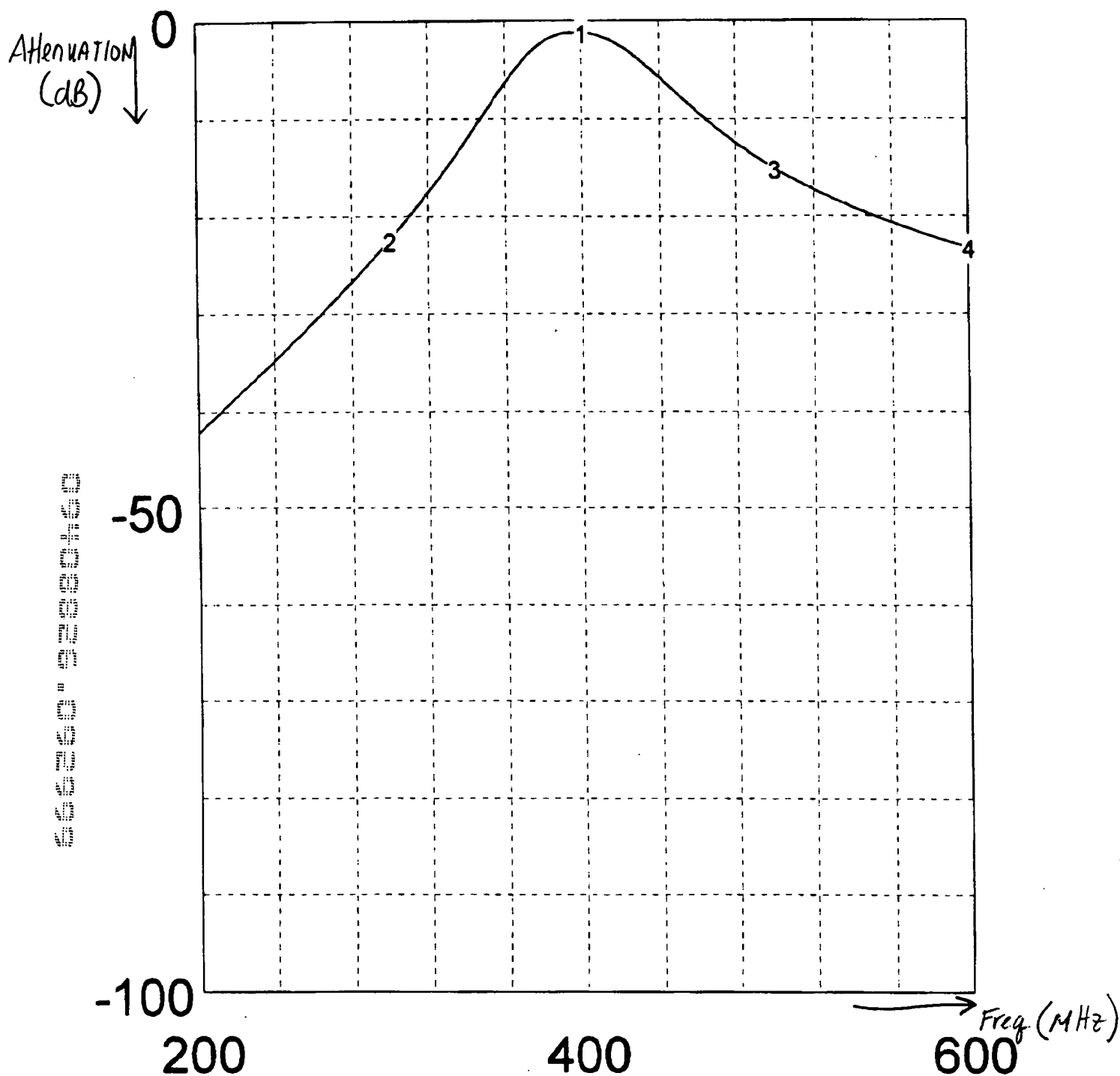
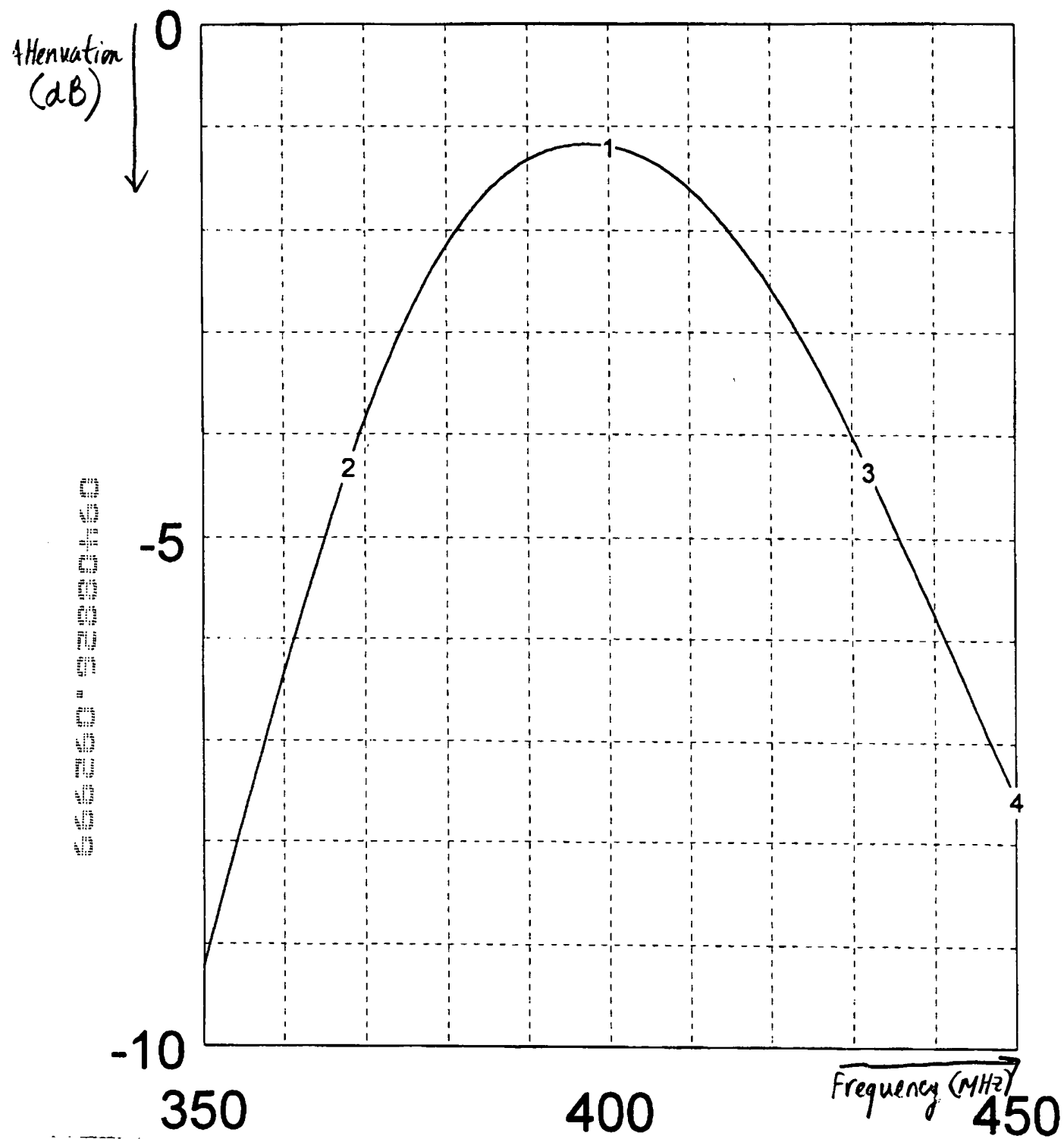


Fig. 3 (Prior Art)



$1 \begin{cases} 400 \\ -1.19704 \end{cases}$
 $2 \begin{cases} 300 \\ -22.4326 \end{cases}$
 $3 \begin{cases} 500 \\ -15.0734 \end{cases}$
 $4 \begin{cases} 600 \\ -23.2958 \end{cases}$

Fig. 4a (Prior Art)



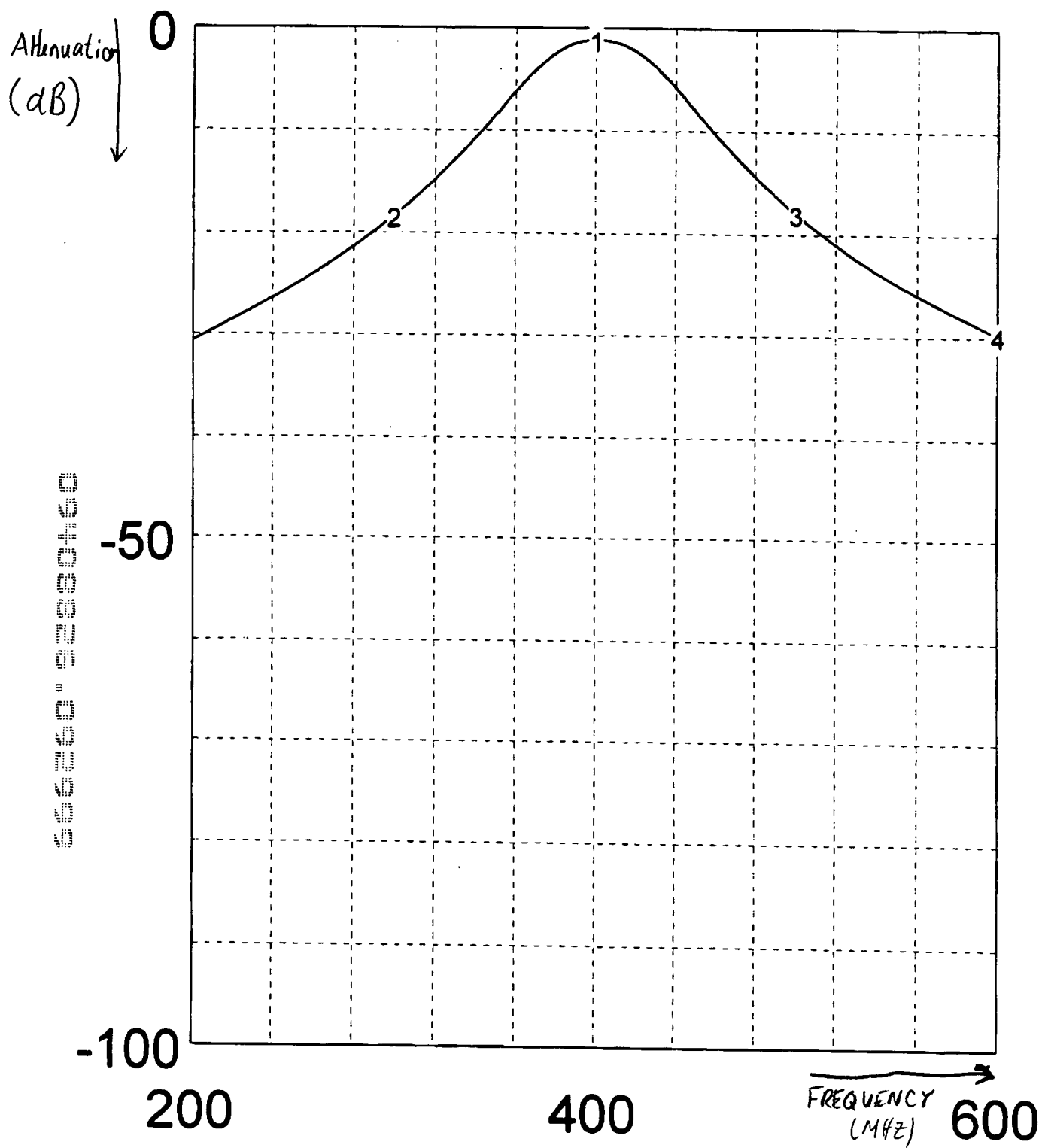
1 { 400
-1.19704

2 { 368
-4.31096

3 { 432
-4.34352

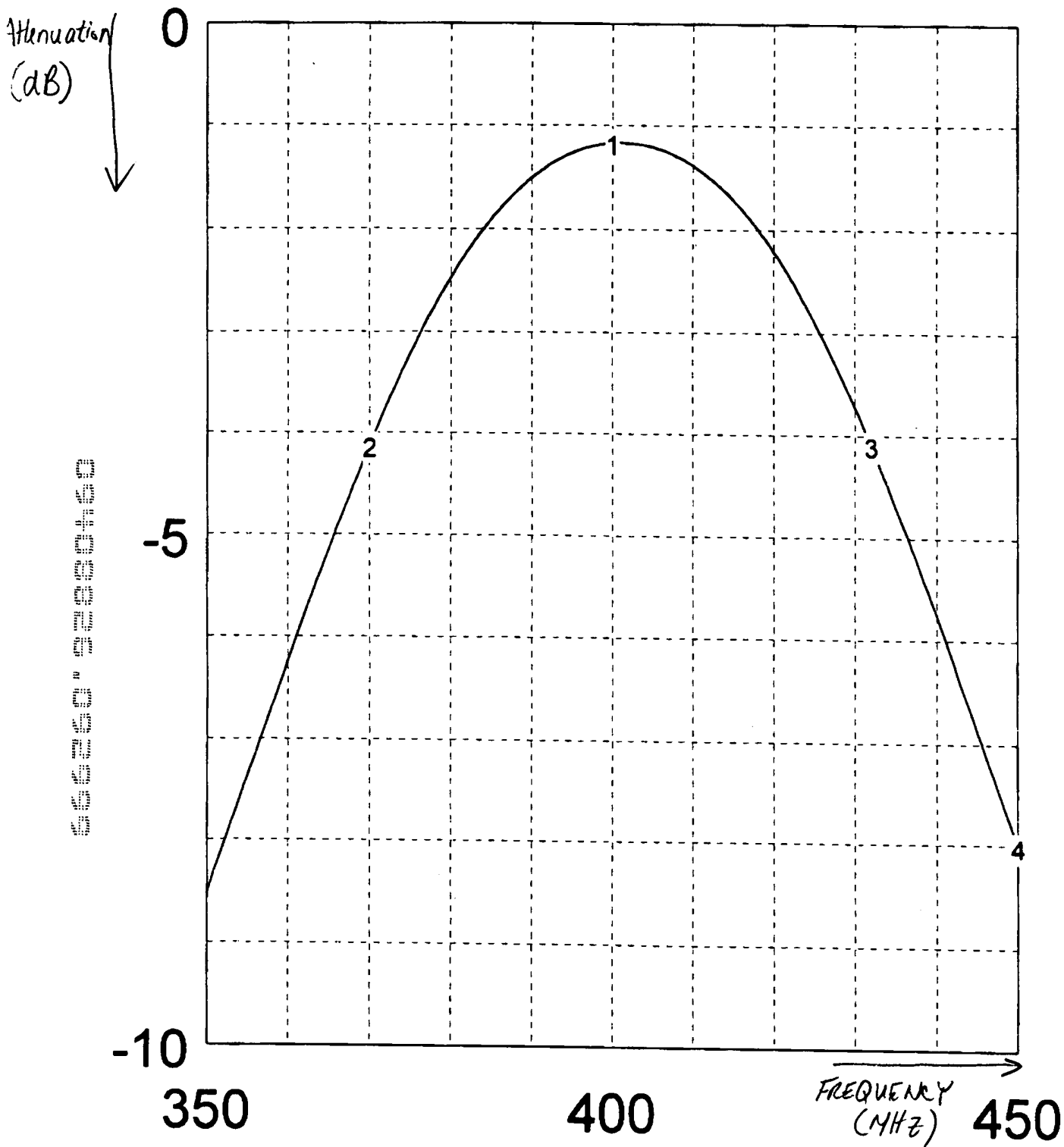
4 { 450
-7.56287

Fig. 4b (Prior Art)



$1 \begin{cases} 400 \\ -1.16808 \end{cases}$
 $2 \begin{cases} 300 \\ -18.3617 \end{cases}$
 $3 \begin{cases} 500 \\ -17.9297 \end{cases}$
 $4 \begin{cases} 600 \\ -29.7704 \end{cases}$

FIG 6a (Prior Art)



$1 \begin{cases} 400 \\ -1.16808 \end{cases}$
 $2 \begin{cases} 370 \\ -4.13039 \end{cases}$
 $3 \begin{cases} 432 \\ -4.09188 \end{cases}$
 $4 \begin{cases} 450 \\ -8.01465 \end{cases}$

Fig. 6b (Prior Art)

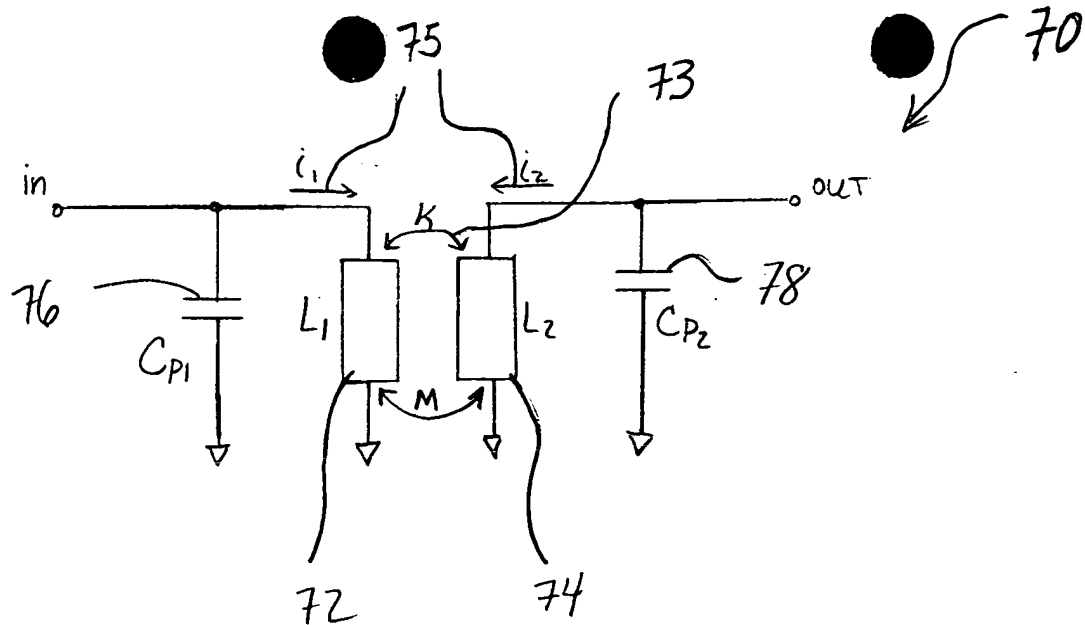


Fig. 7

Downloaded from ascelibrary.org by Seattle University on 06/01/15

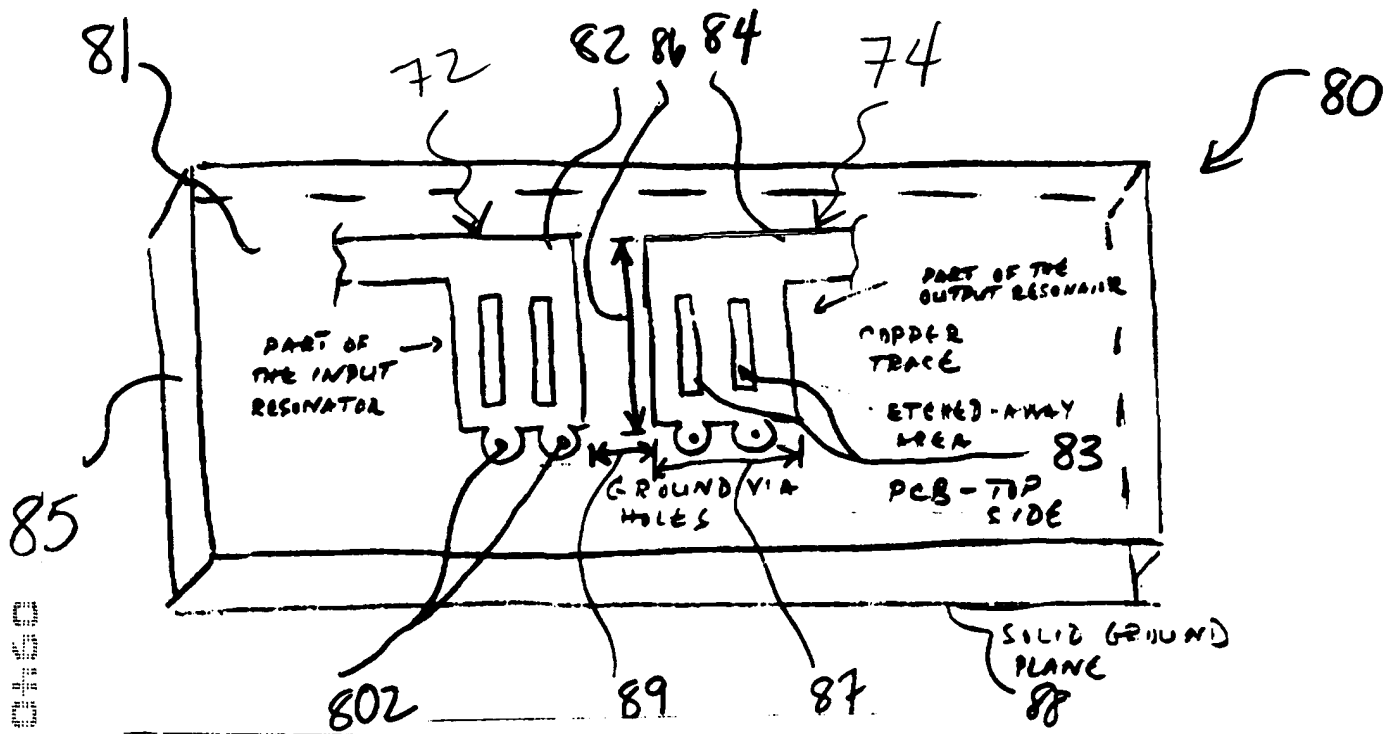
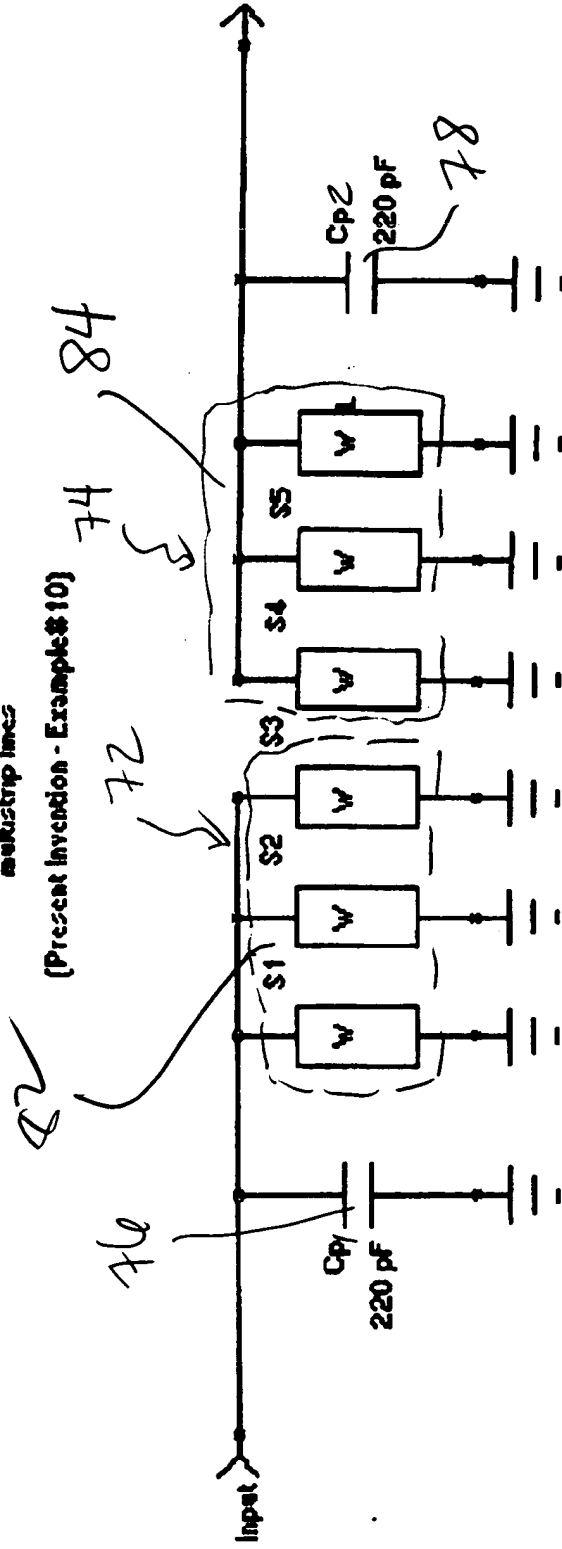


Fig. 8a

400 MHz Band Pass Filter

Parallel coupled double tuned
multistrip lines

(Present Invention - Example # 10)



Multistrip coupled microstrip

line (2 resonators, 3 lines each)

Width $W=2$ mm, Length $L=5.5$ mm

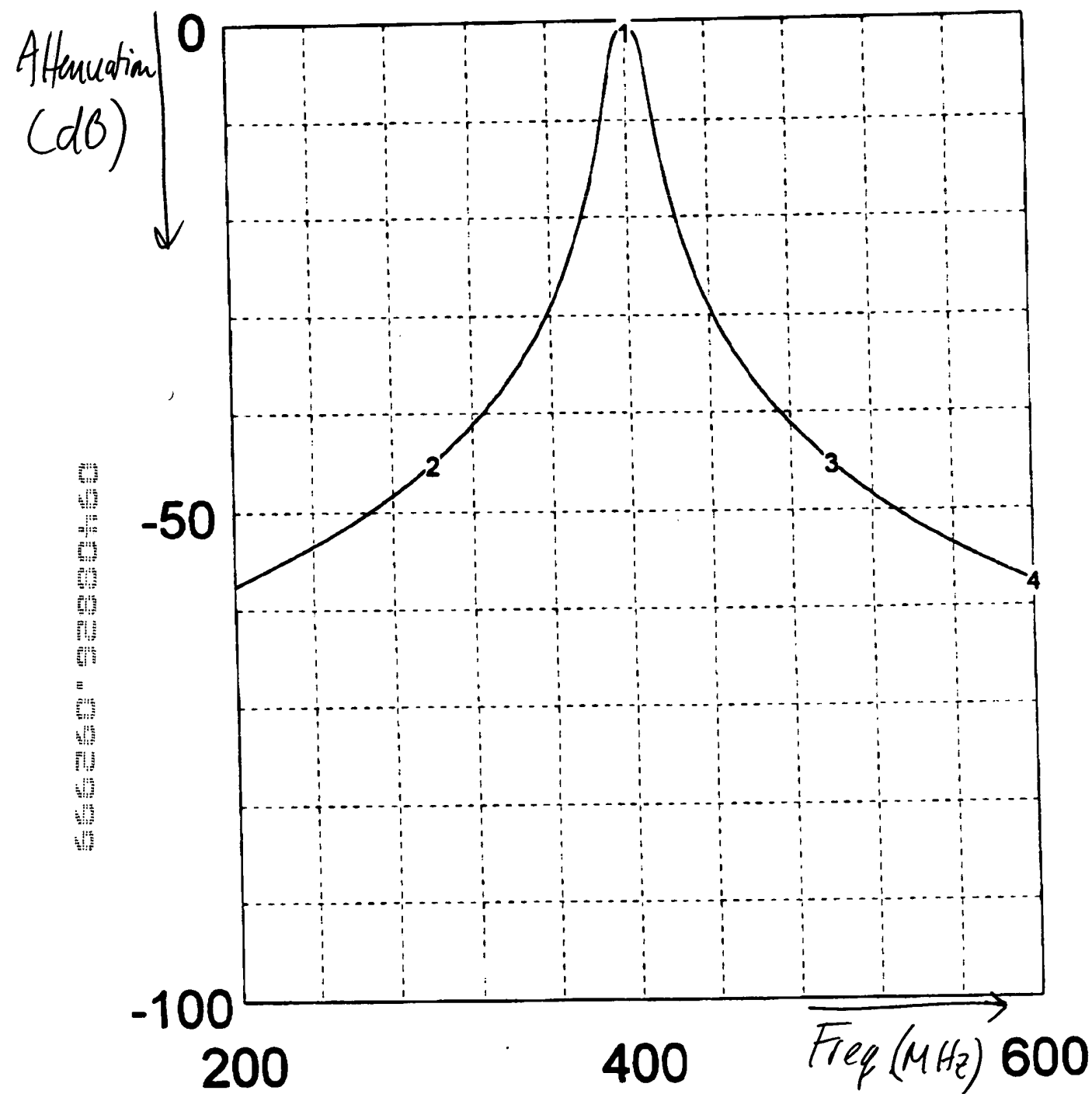
Gaps: $S1=S2=S4=S5=3.45$ mm

$S3=3$ mm

Dielectric: $\epsilon_r=4.65$, $\tan\delta=0.001$

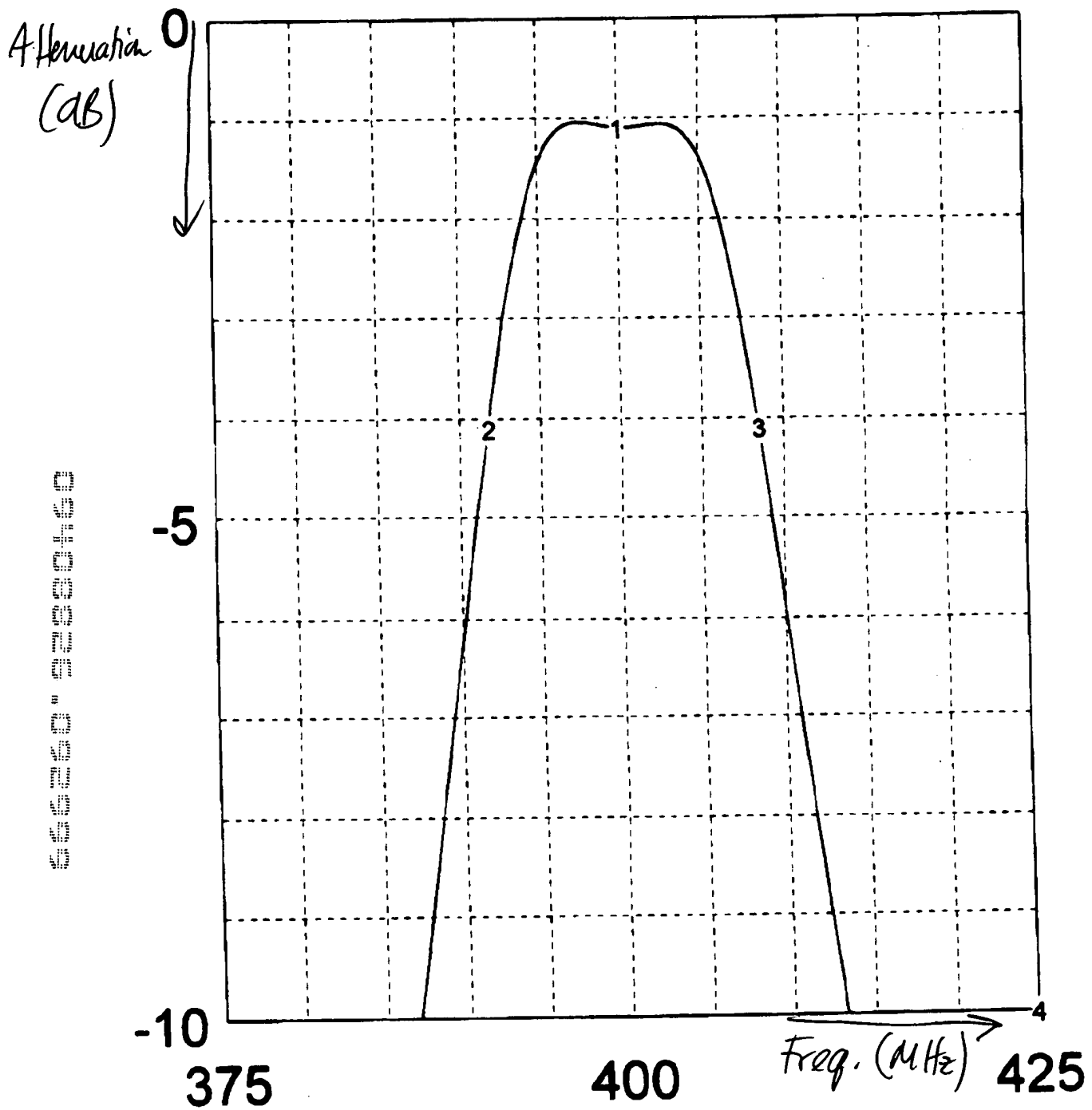
Board thickness (height) $H=1.5$ mm

Fig. 8b



400	300	500	600
-1.09187	-45.092	-45.1217	-57.4546

Fig. 9a



400	391.75	408.5	425
-1.09187	-4.09212	-4.08623	-20.7976

Fig. 9b

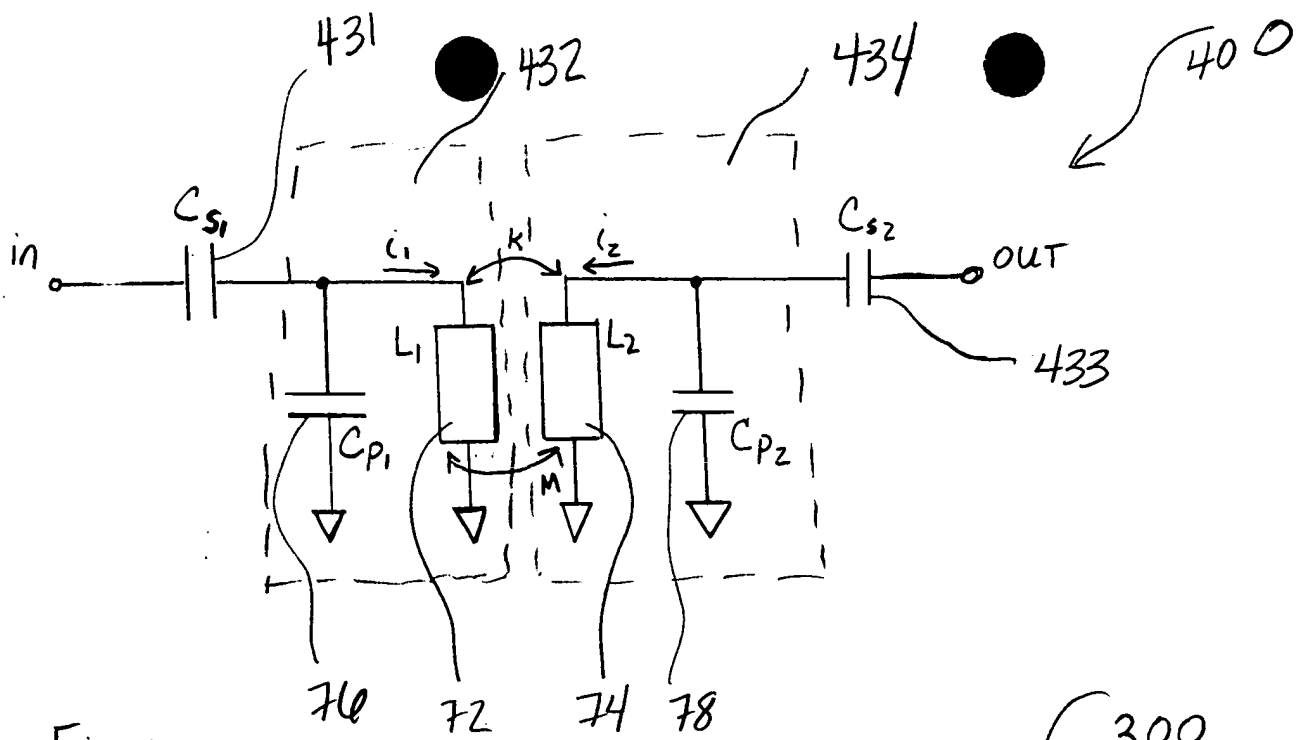


Fig. 10a

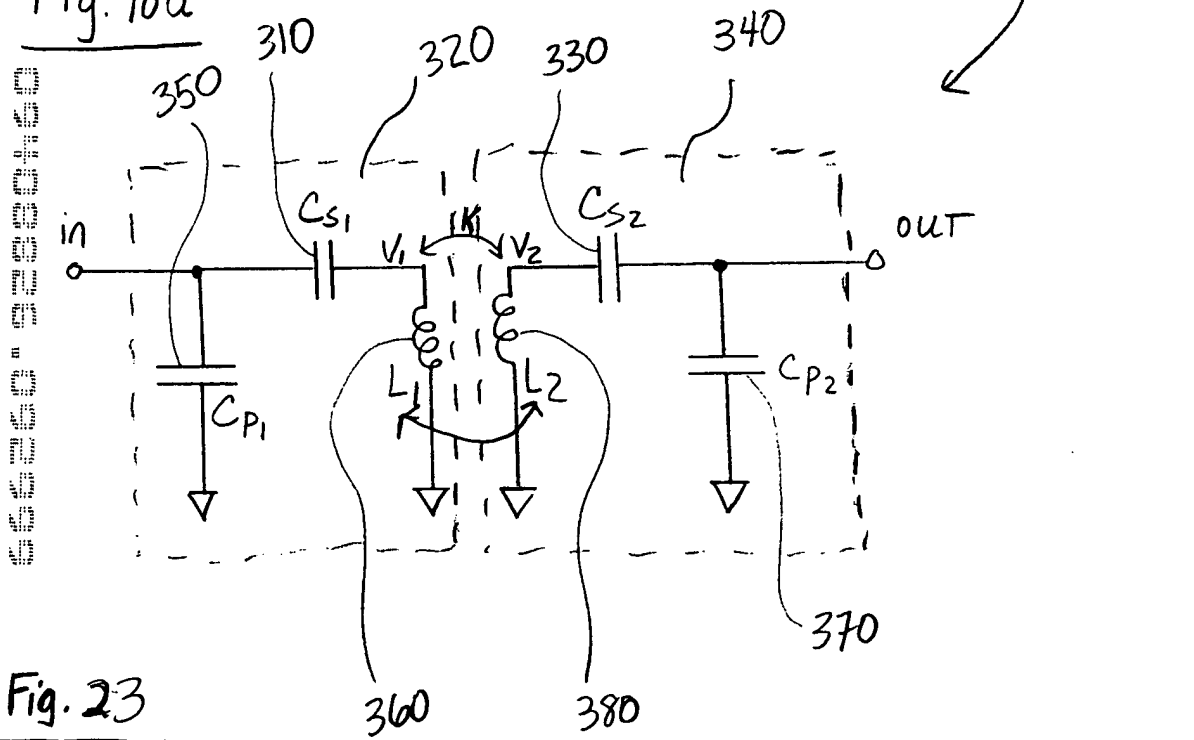
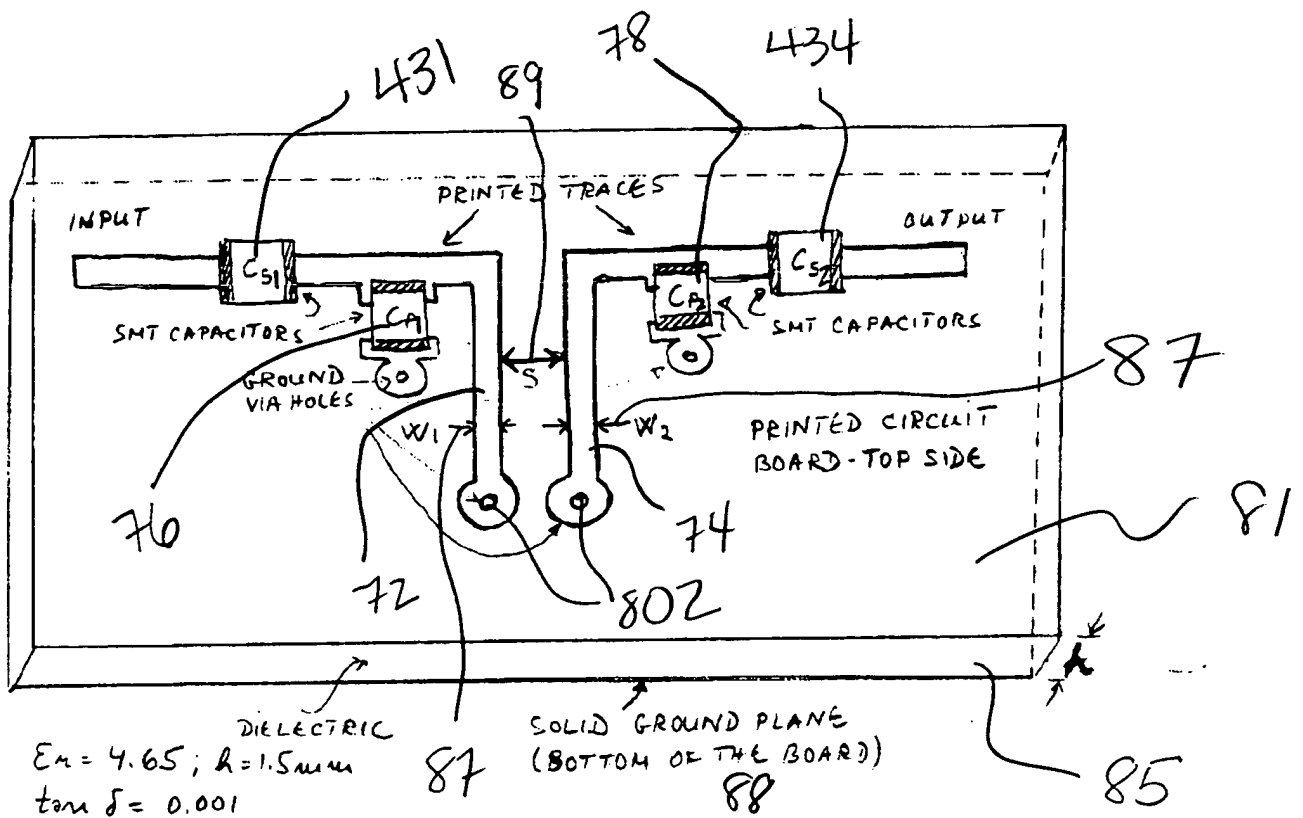


Fig. 23



(ONE EMBODIMENT)

FIGURE — : CONSTRUCTION OF THE COUPLED PARALLEL RESONATORS IN THE PRESENT INVENTION

Fig. 10b

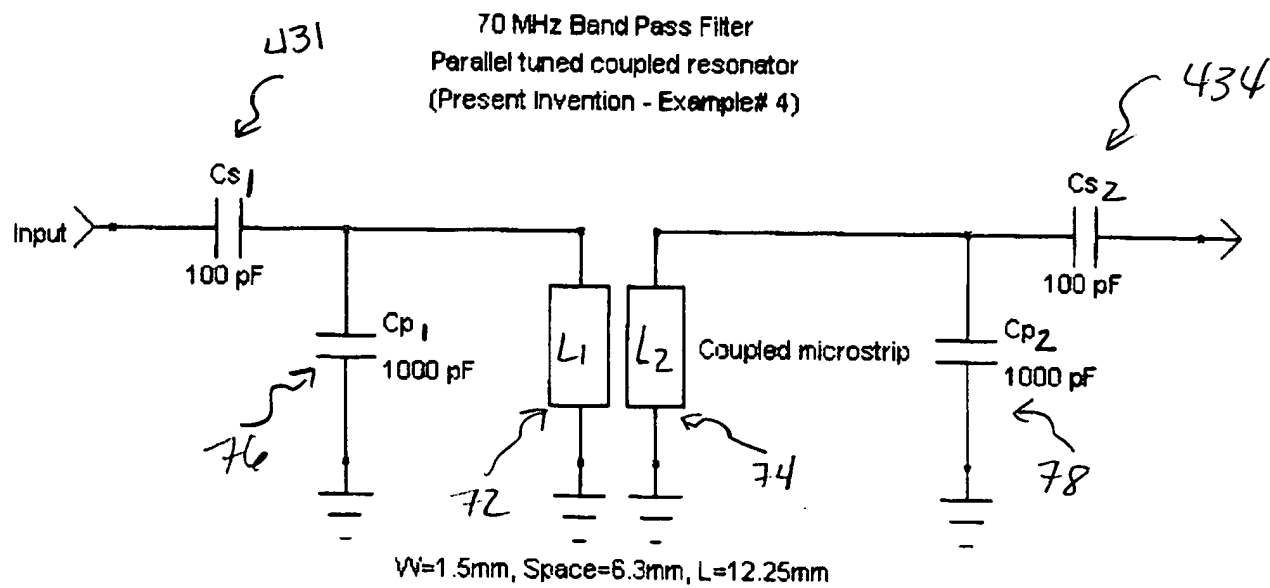
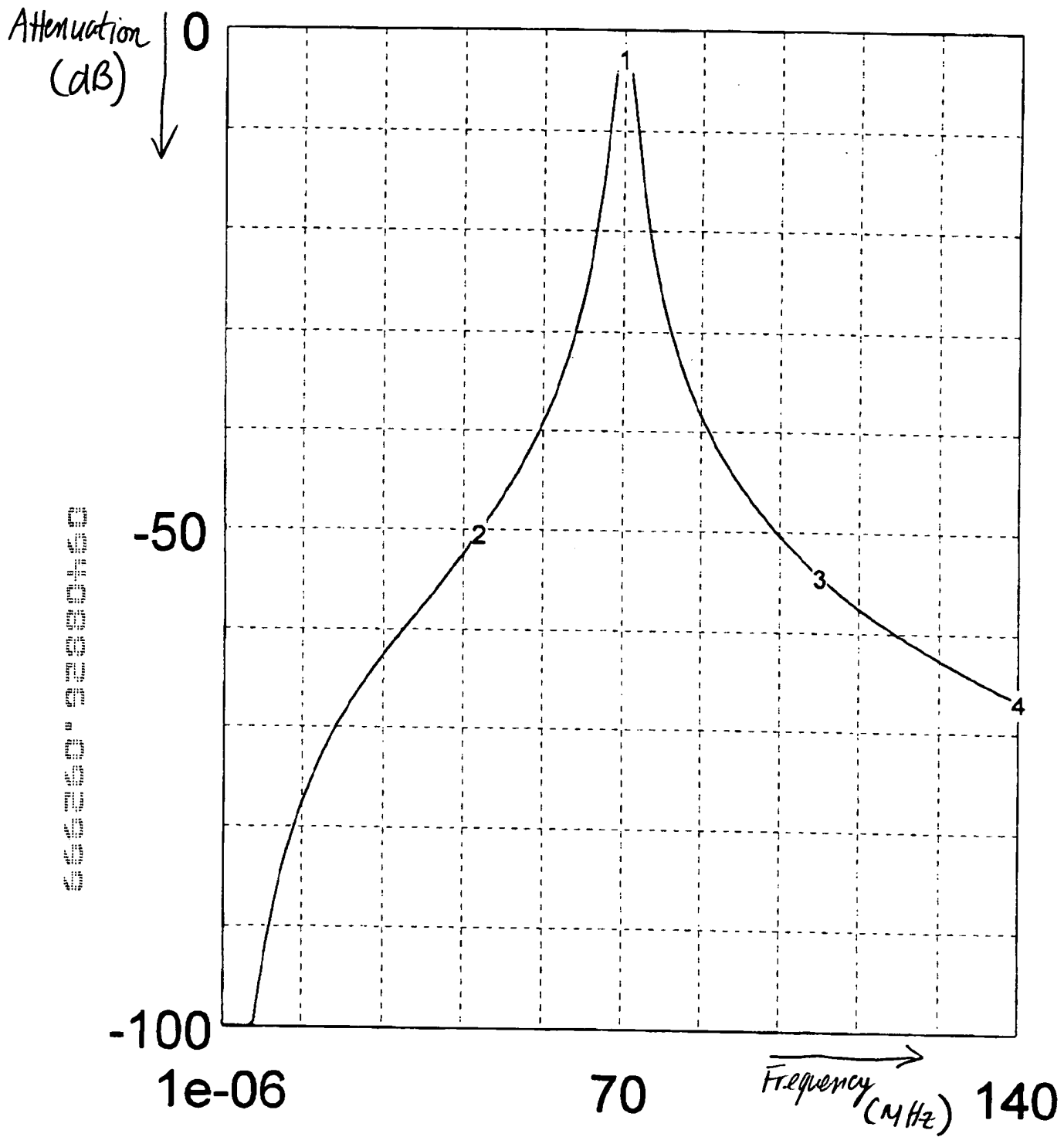
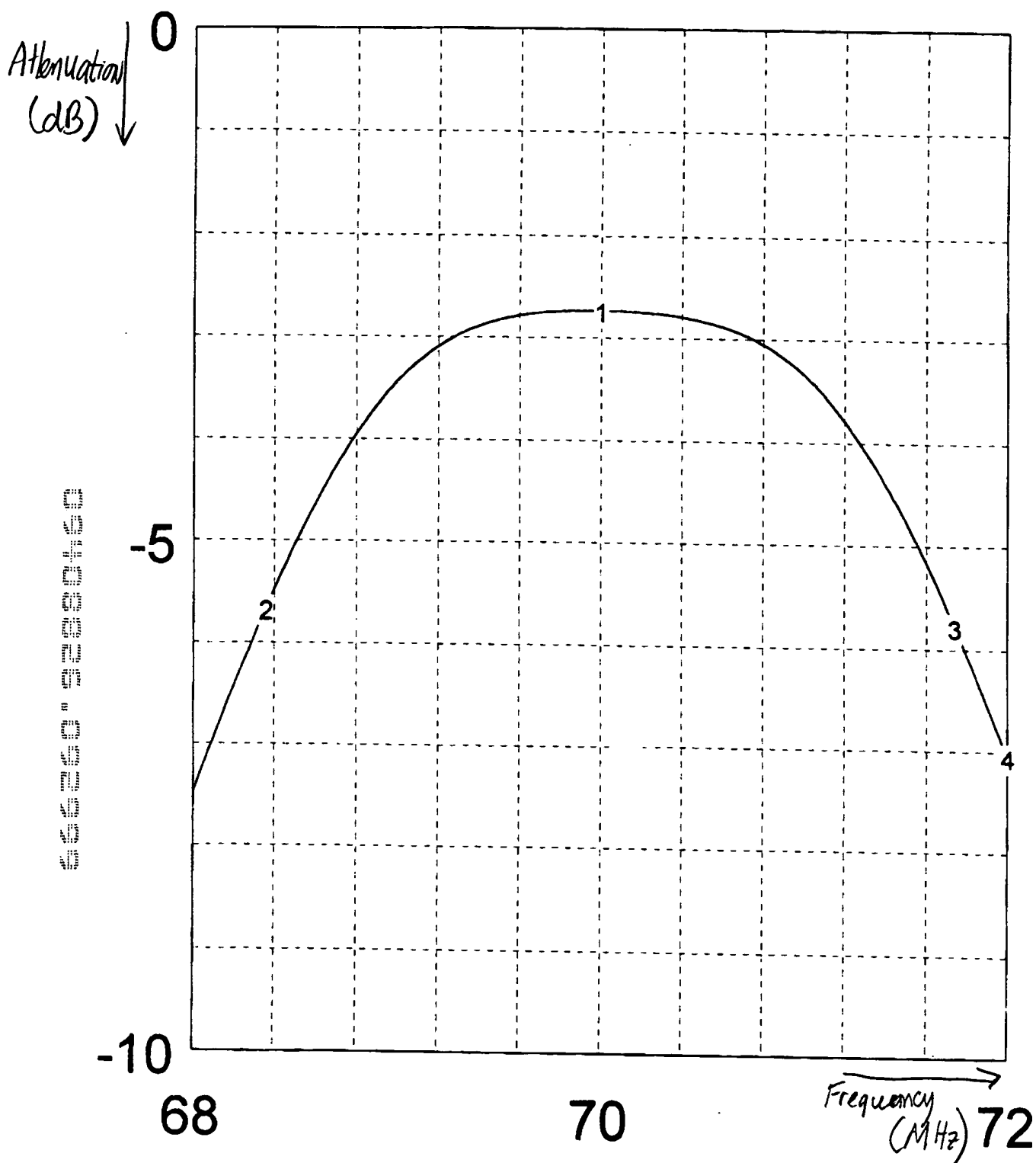


Fig. 11



70	44.8	105	140
-2.7315	-50.2972	-54.2752	-66.7522

Fig. 12a



70	68.36	71.74	72
-2.7315	-5.67056	-5.77978	-7.05591

Fig. 12b

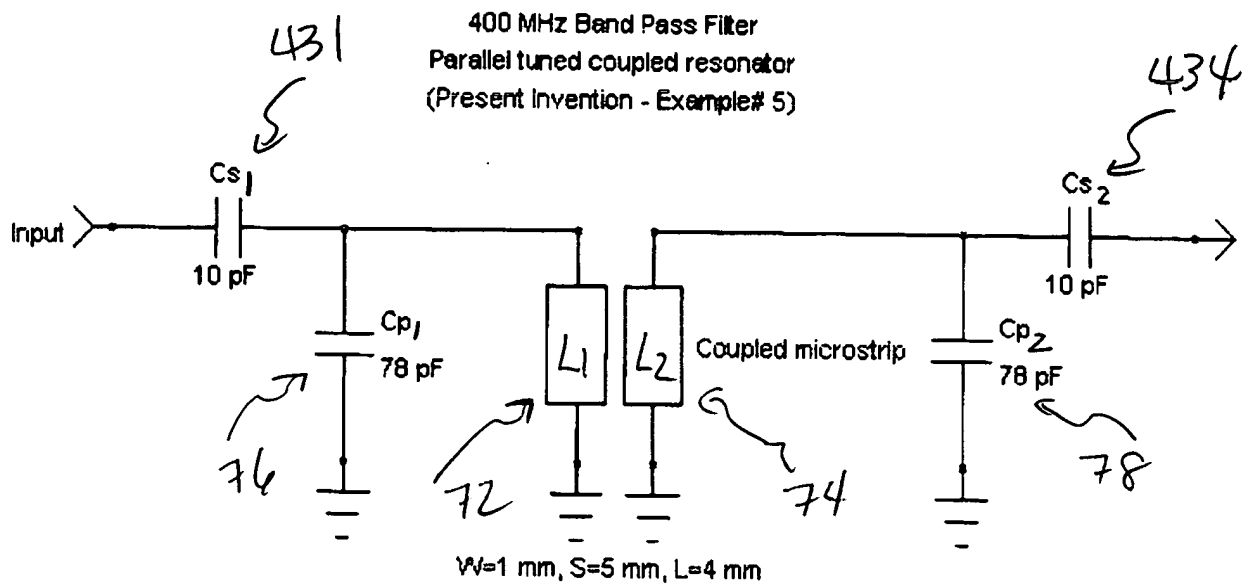
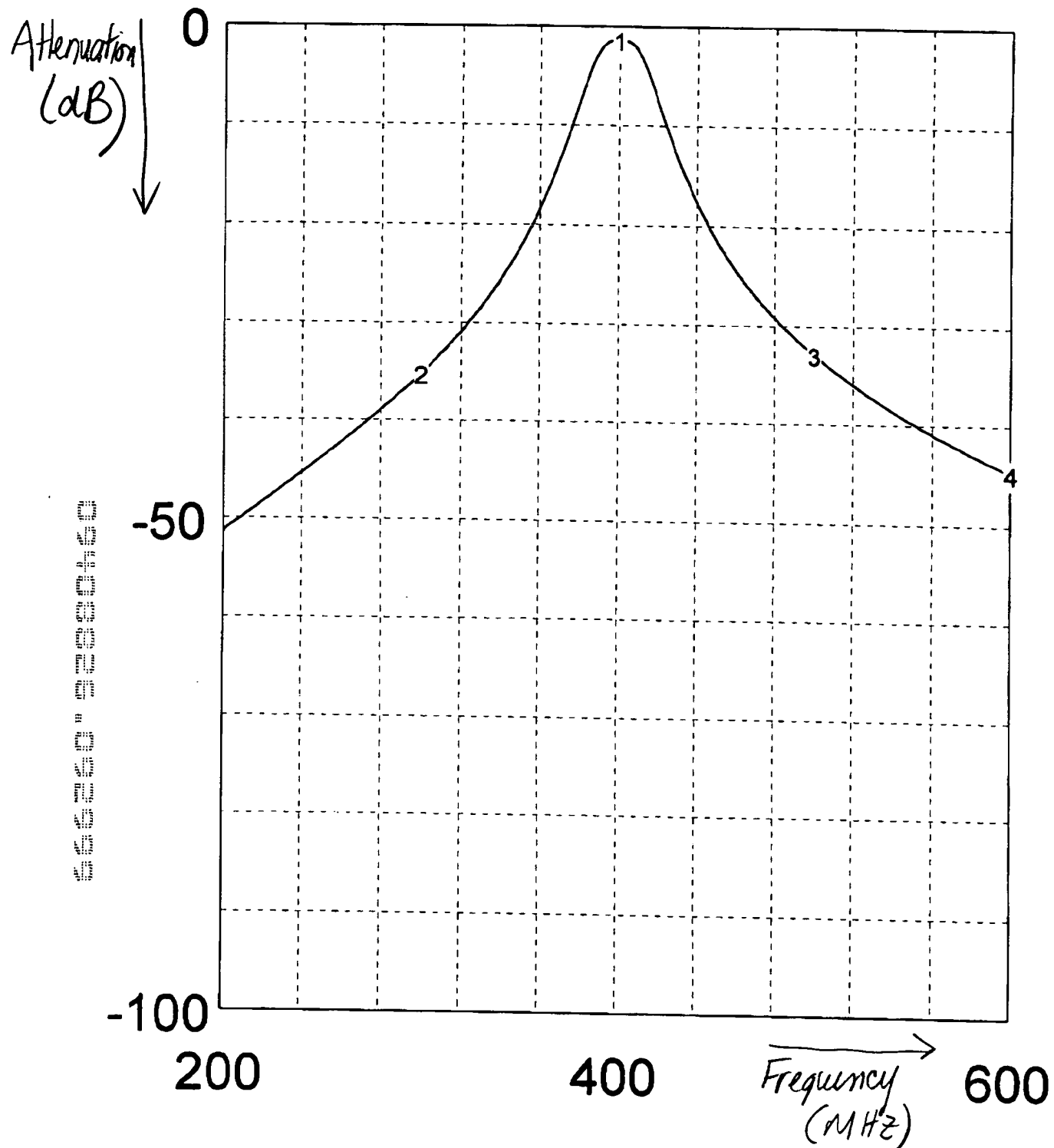


Fig. 13

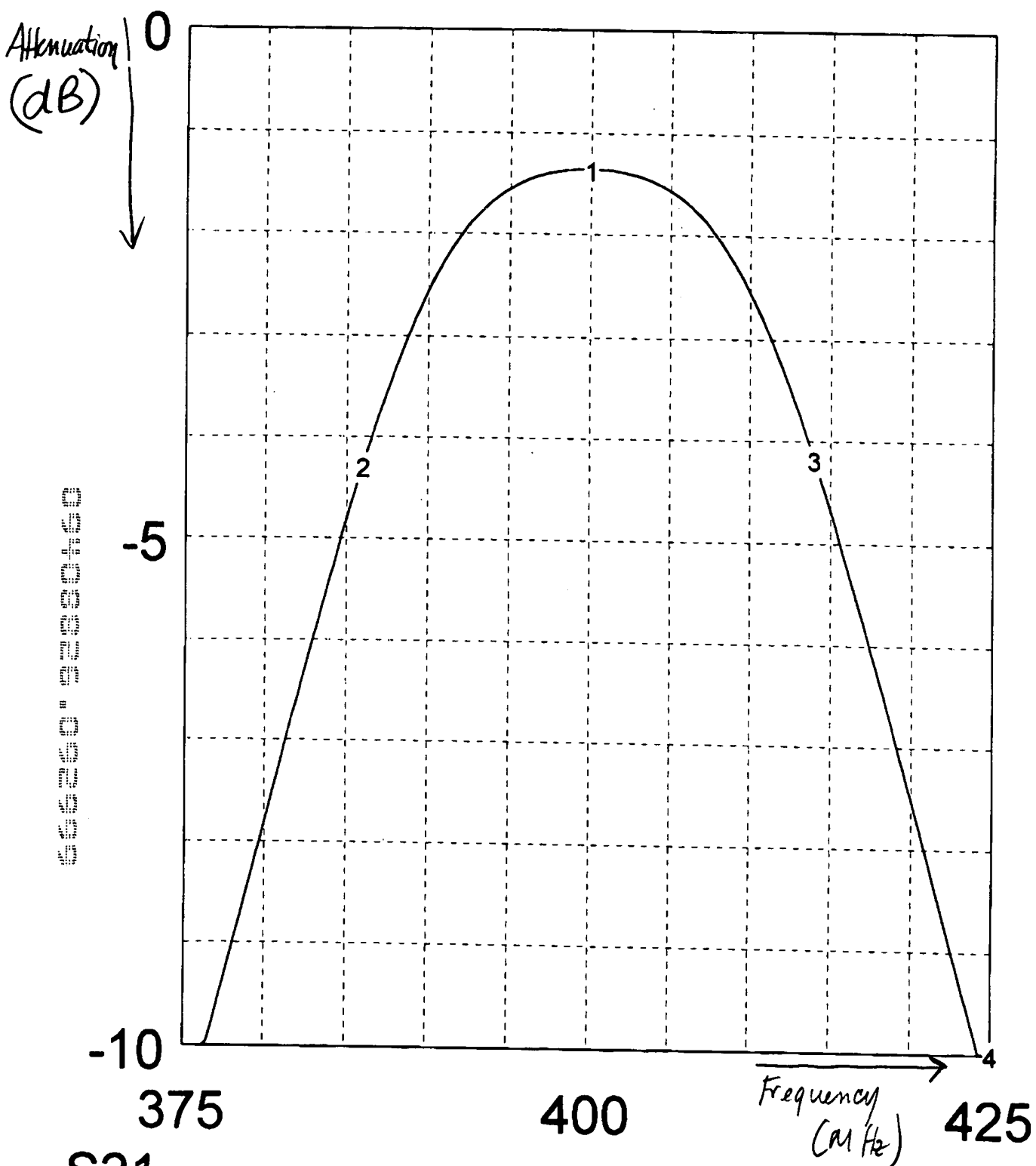
66260" 2230460



400	300	500	600
-1.34992	-35.2672	-32.9034	-44.6979

Fig. 14a

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S21 —

400	386	414	425
-1.34992	-4.28796	-4.17562	-10.417

Fig. 146

800 MHz Band Pass Filter
Parallel tuned coupled resonator
(Present Invention - Example# 6)

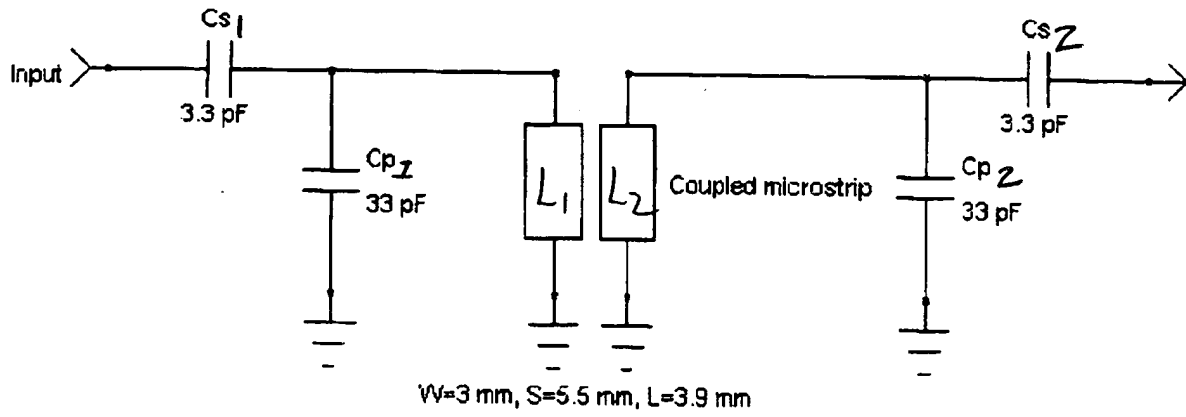


Fig. 15

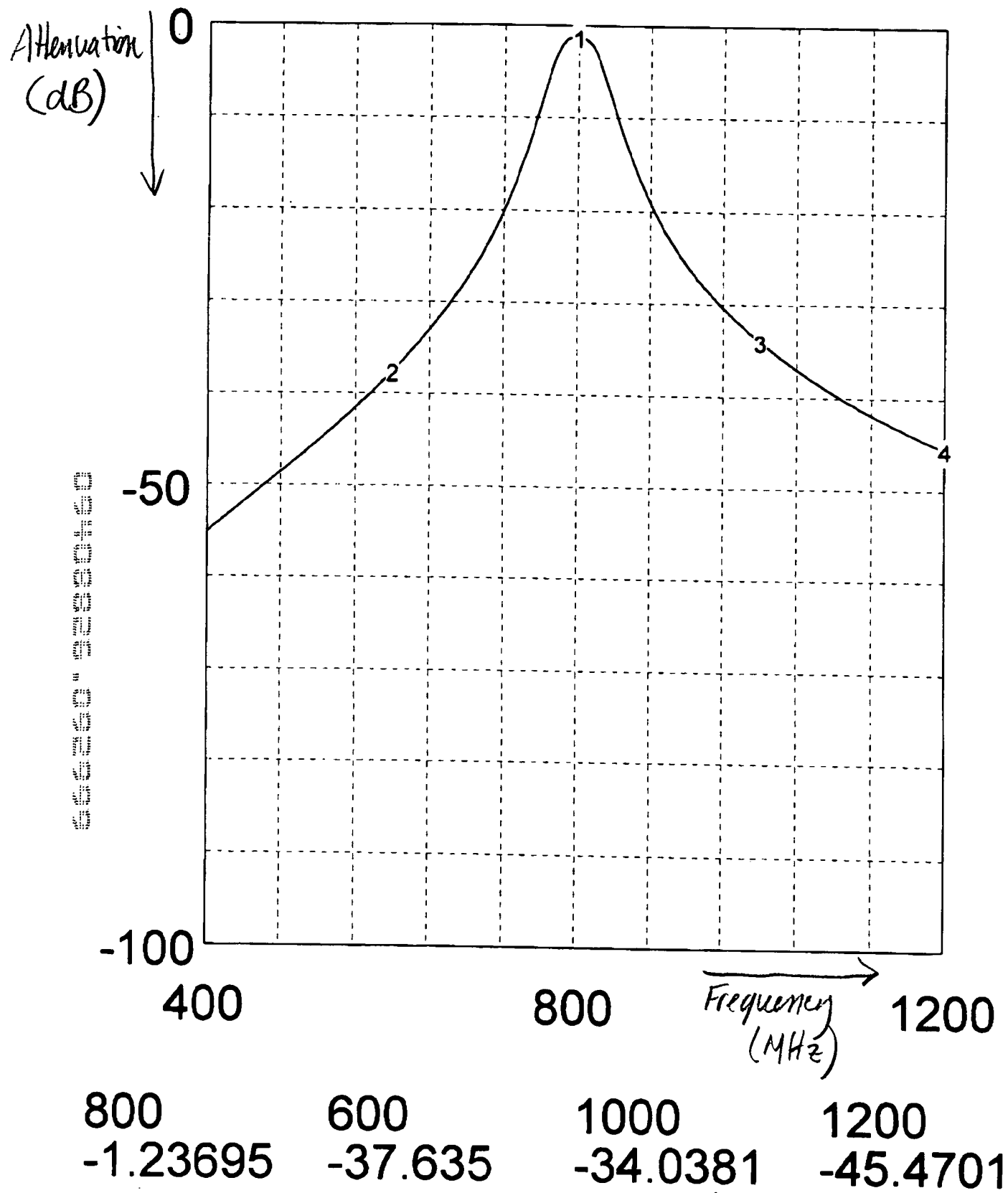
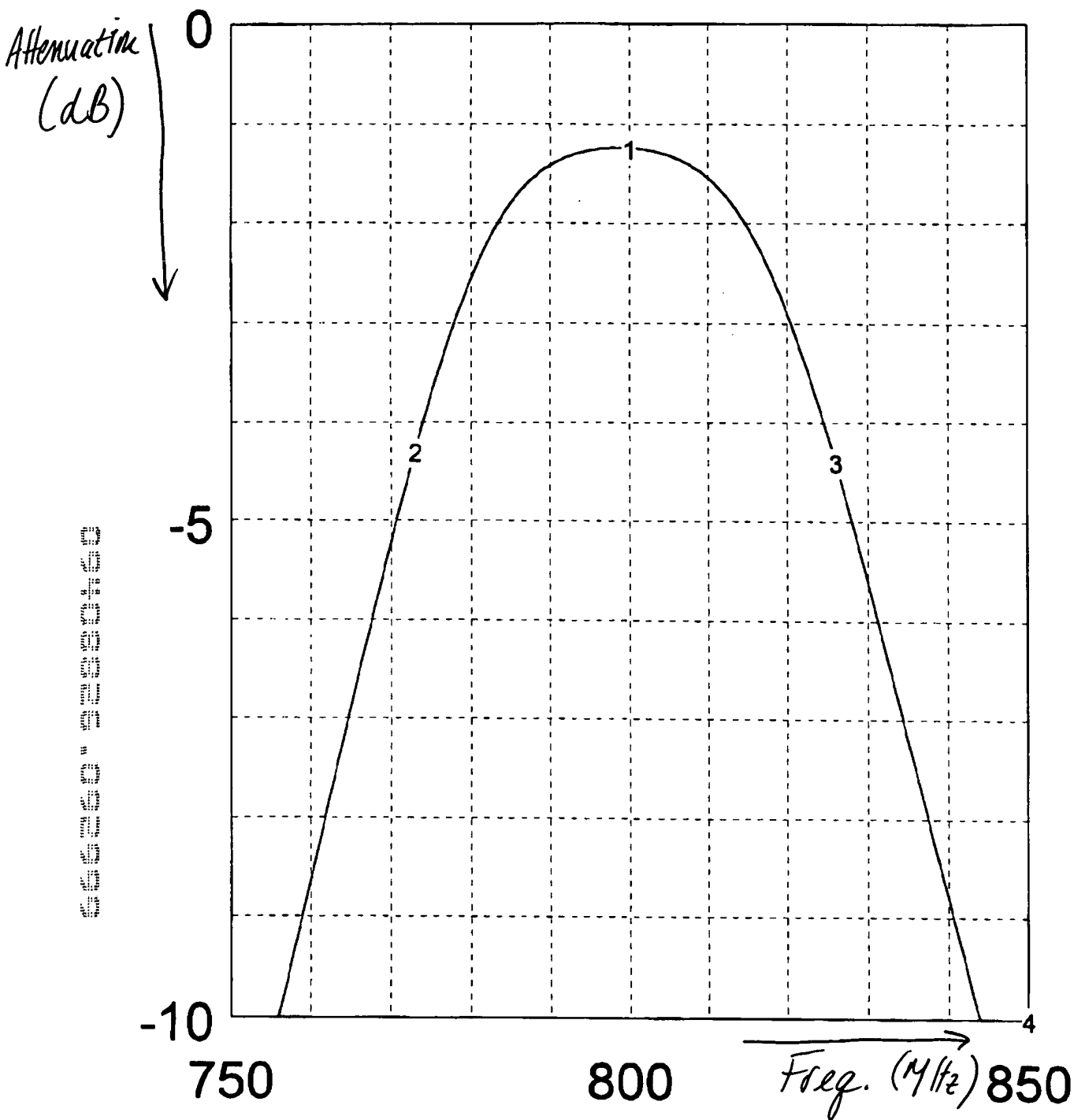


Fig. 16a



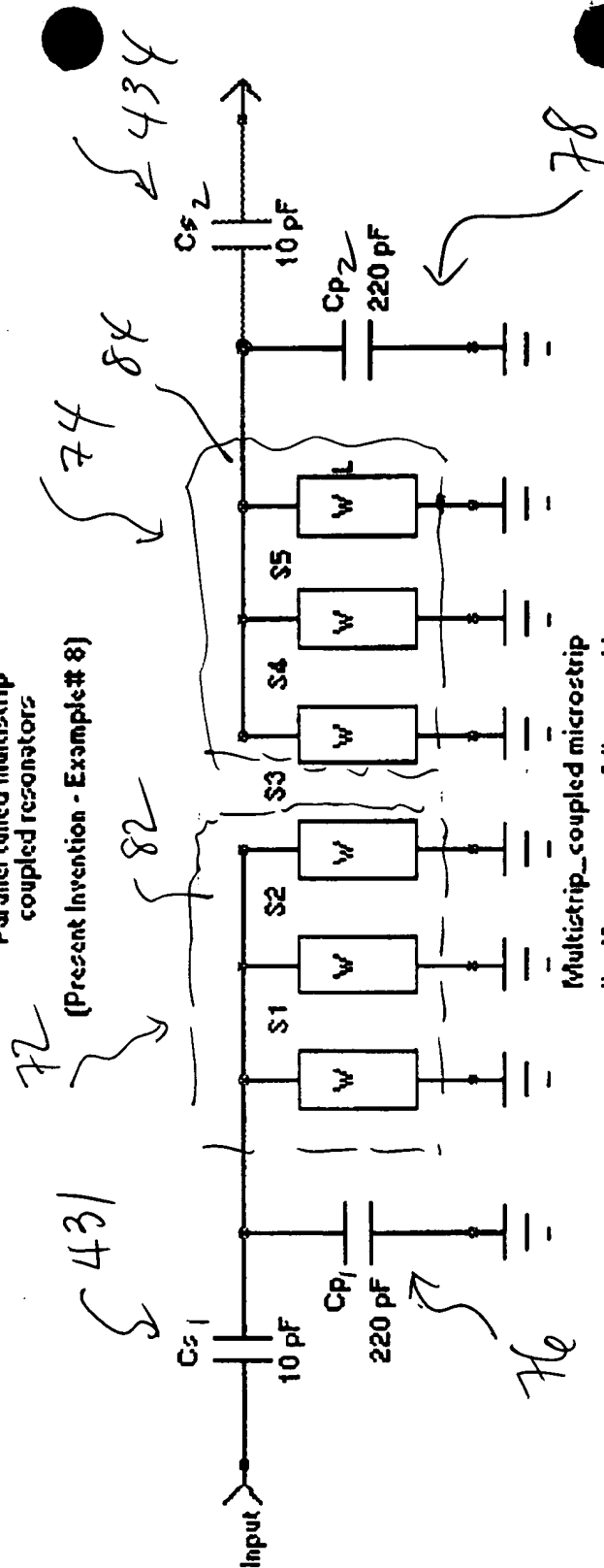
800	773	826	850
-1.23695	-4.29699	-4.39745	-11.8421

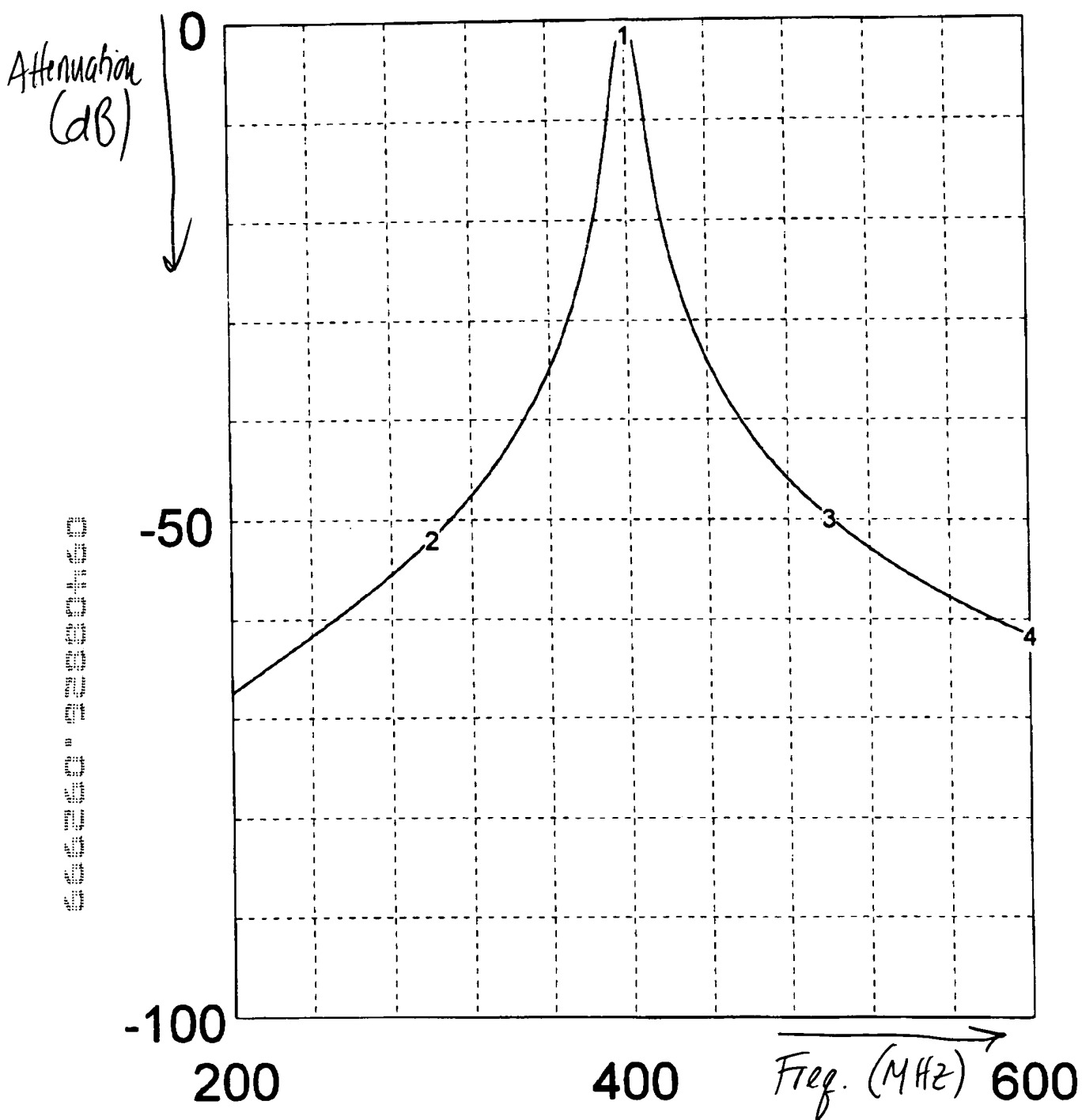
Fig. 16b

400 MHz Band Pass Filter

Parallel tuned multistrip
coupled resonators

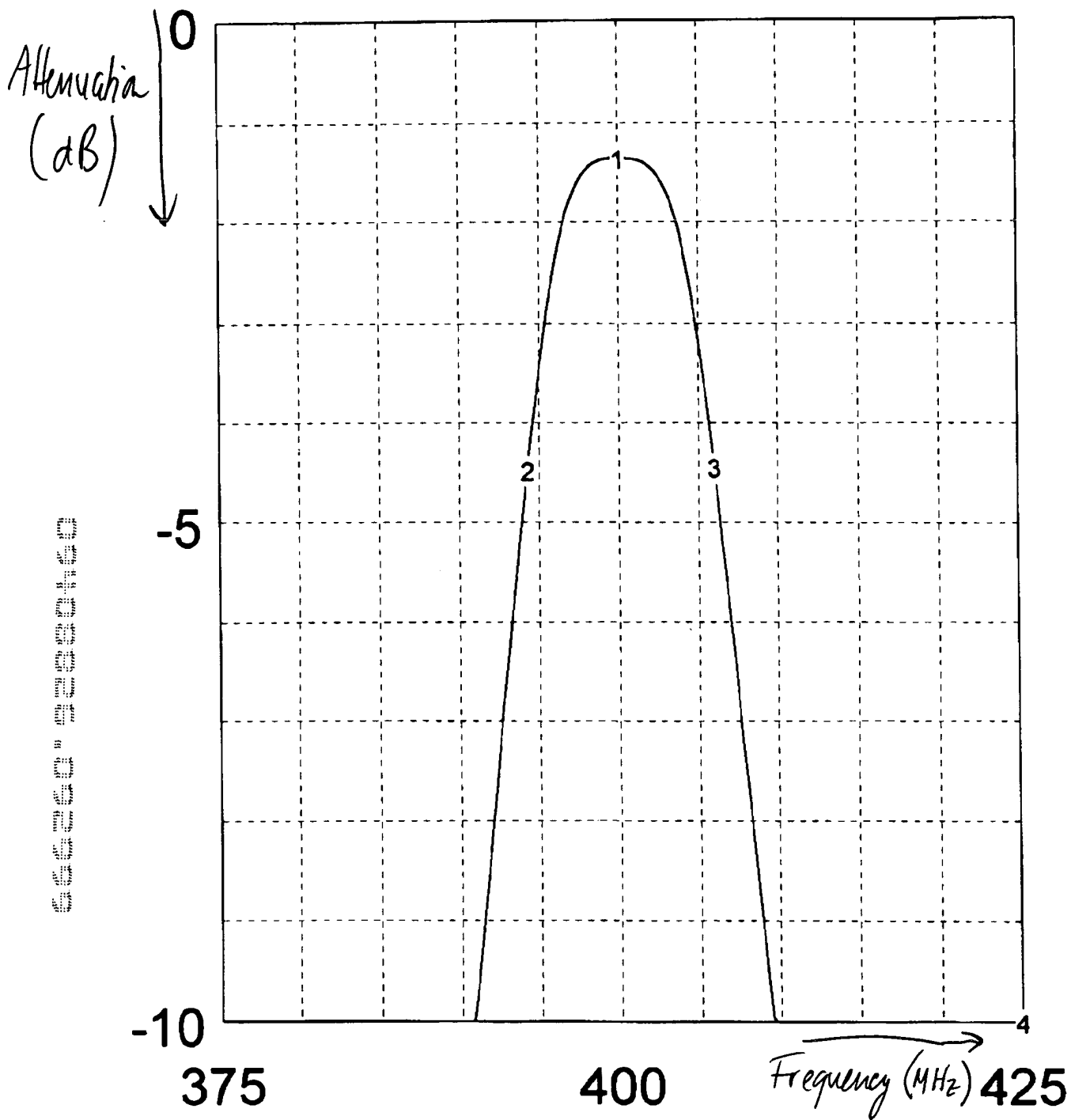
(Present Invention - Example # 8)

Multistrip_coupled microstrip
line(2 resonators, 3 lines each)Width $W=2$ mm, Length $L=5.5$ mmGaps: $S1=S2=S4=S5=3.85$ mm $S3 = 4$ mmDielectric: $\epsilon_r=4.65$, $\tan\delta=0.001$ Board thickness (height) $H=1.5$ mm



400	300	500	600
-1.35185	-51.8681	-49.7486	-61.6452

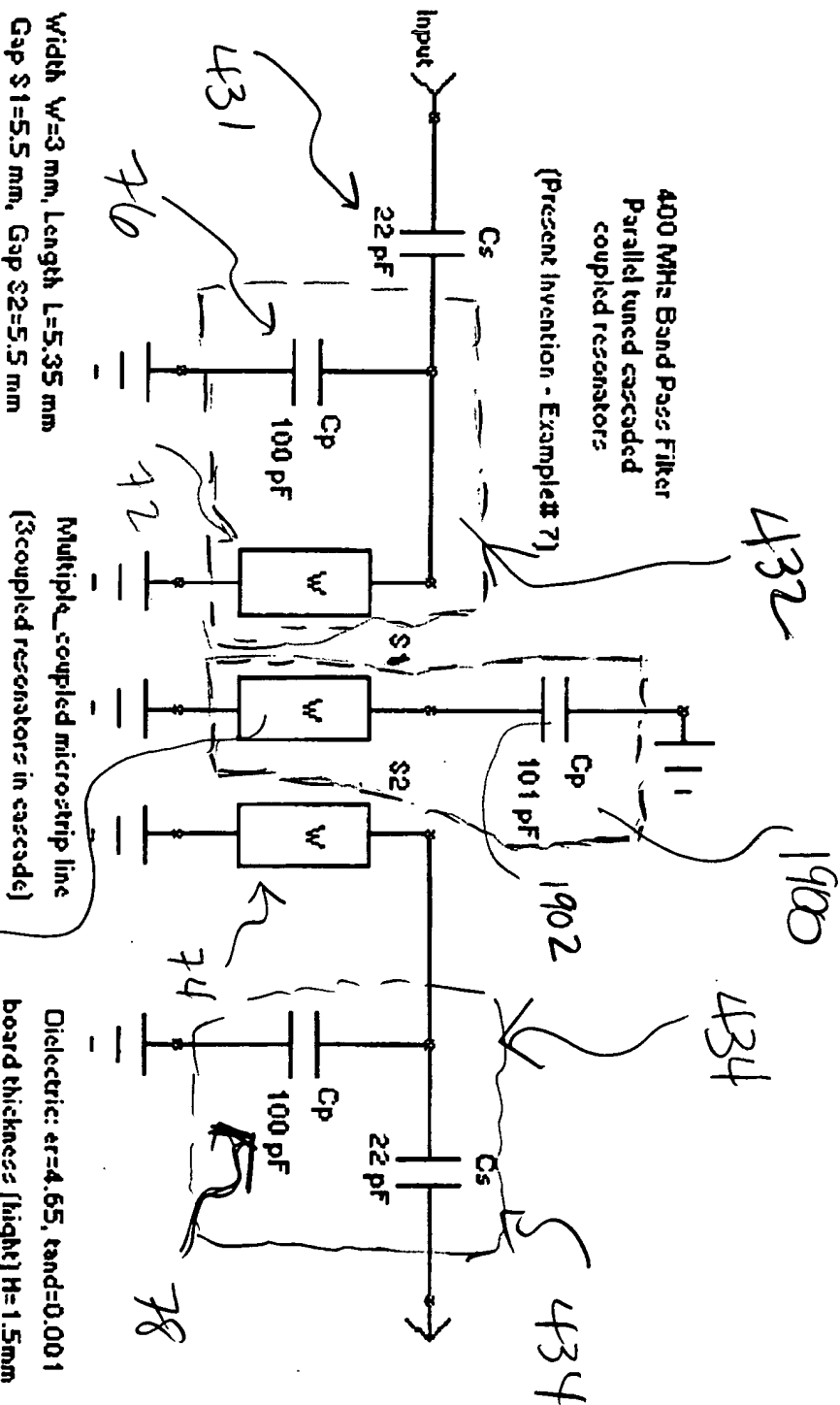
Fig. 18a



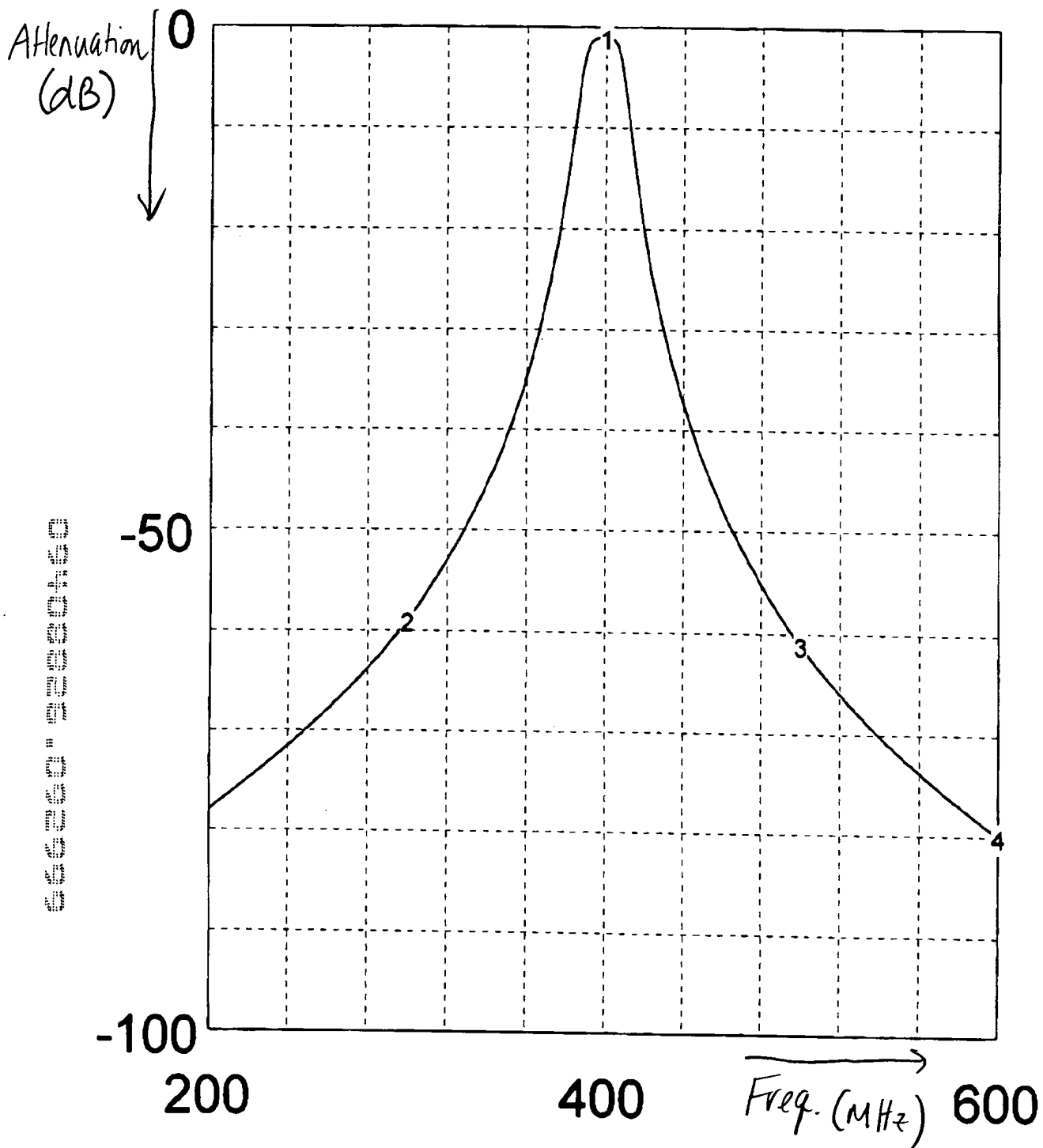
400	394.25	406	425
-1.35185	-4.47513	-4.43991	-26.022

Fig. 18b

Fig. 19



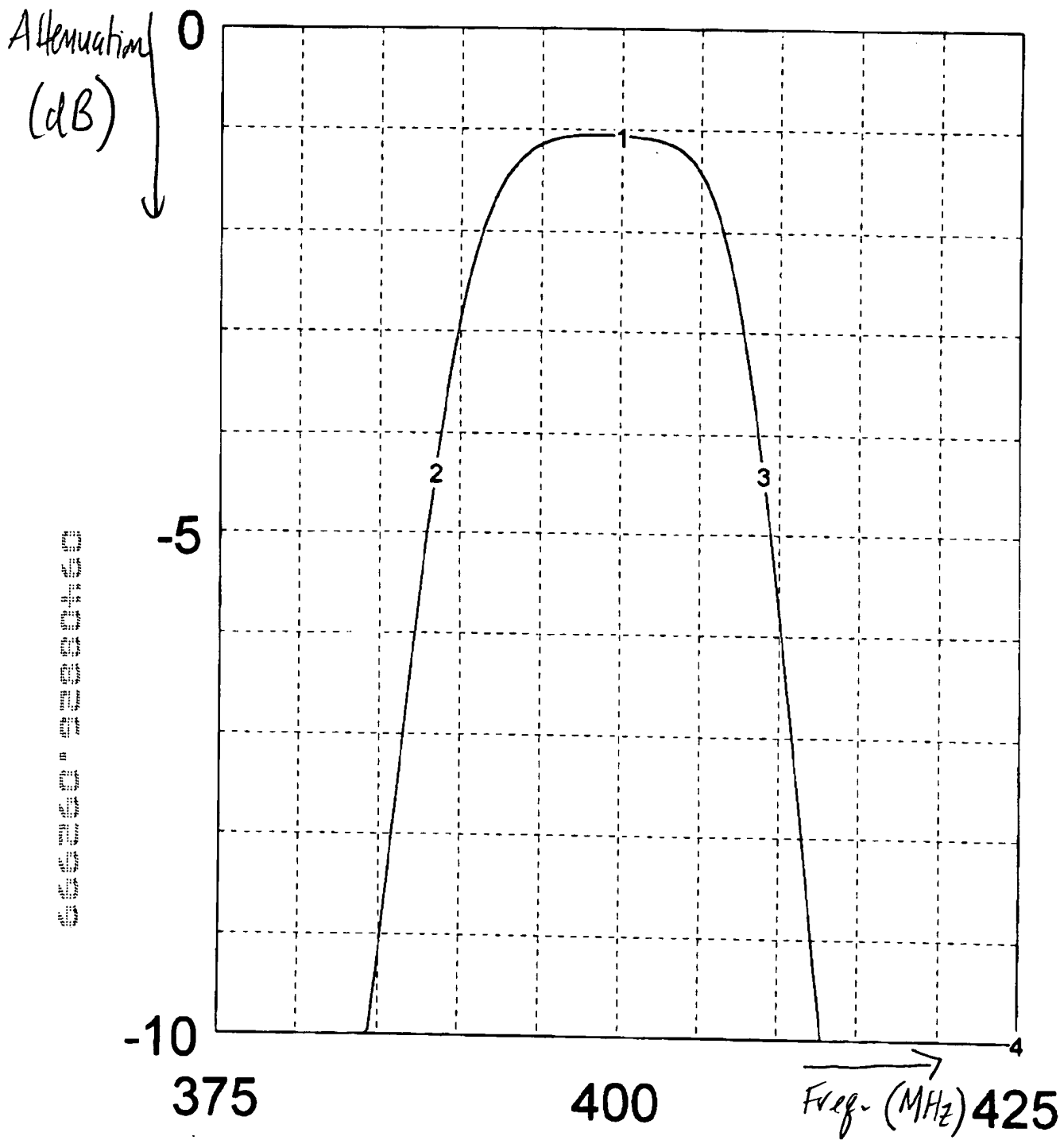
09402226 092999



400	300	500	600
-1.05798	-59.0384	-61.1136	-80.0114

Fig. 20a

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400	388.5	409	425
-1.05798	-4.38529	-4.3905	-25.5458

Fig. 20b

Wide 400 MHz Band Pass Filter(100 MHz BW:Balanced_Unbalanced transformer)
(Present Invention - Example# 9)

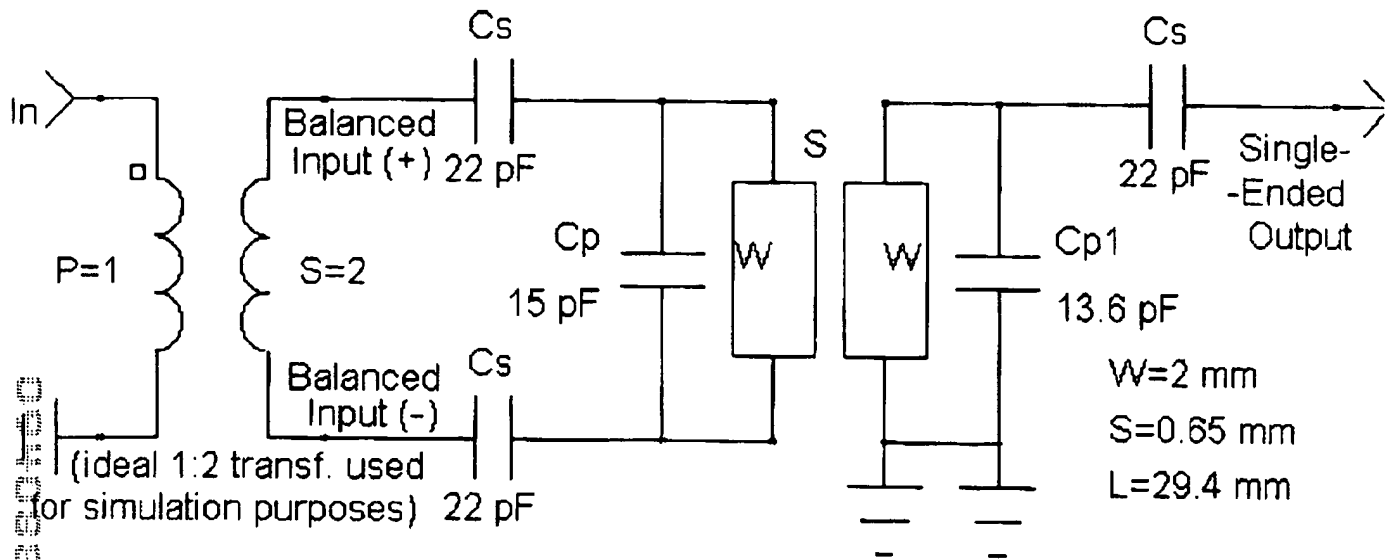
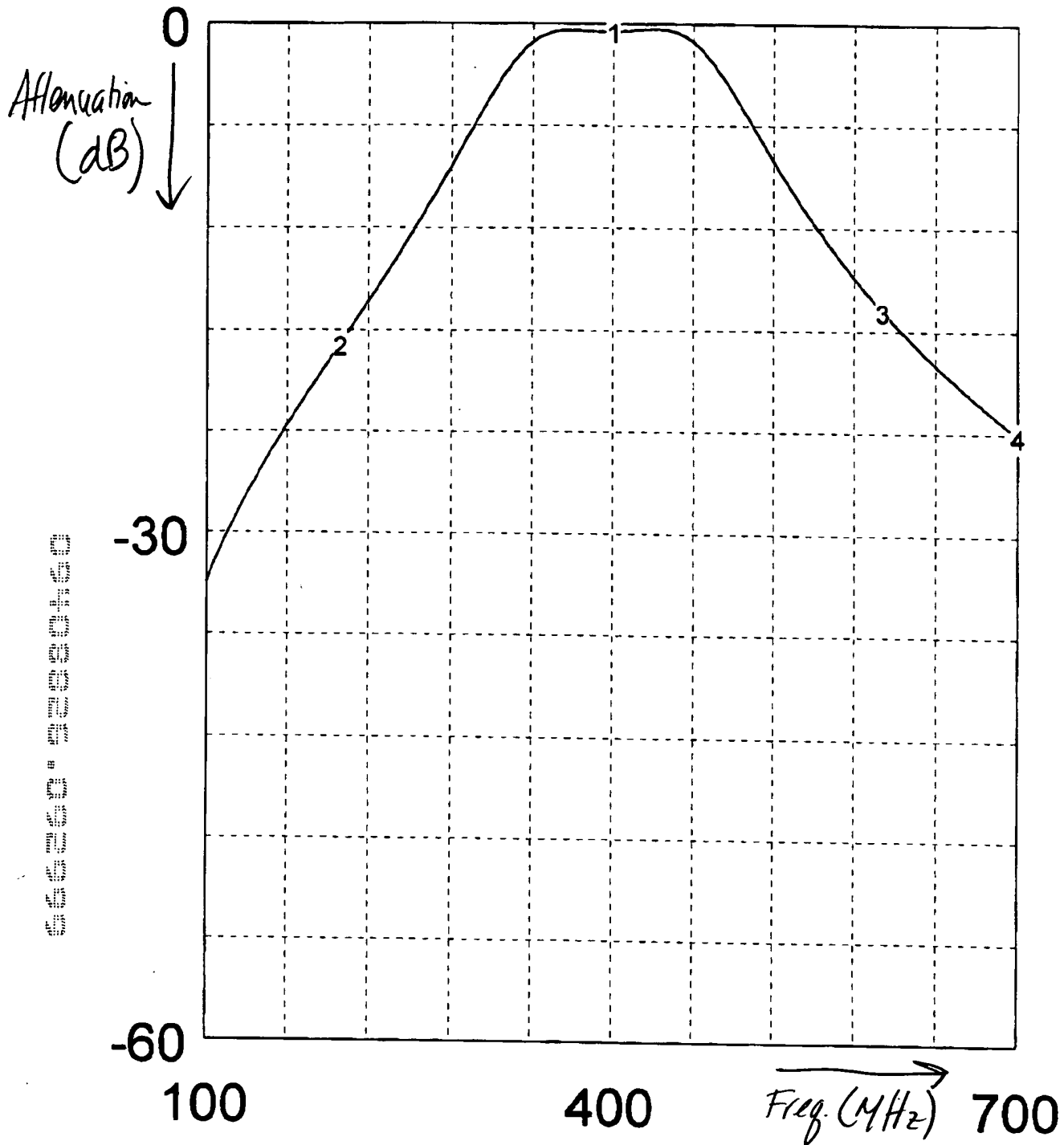
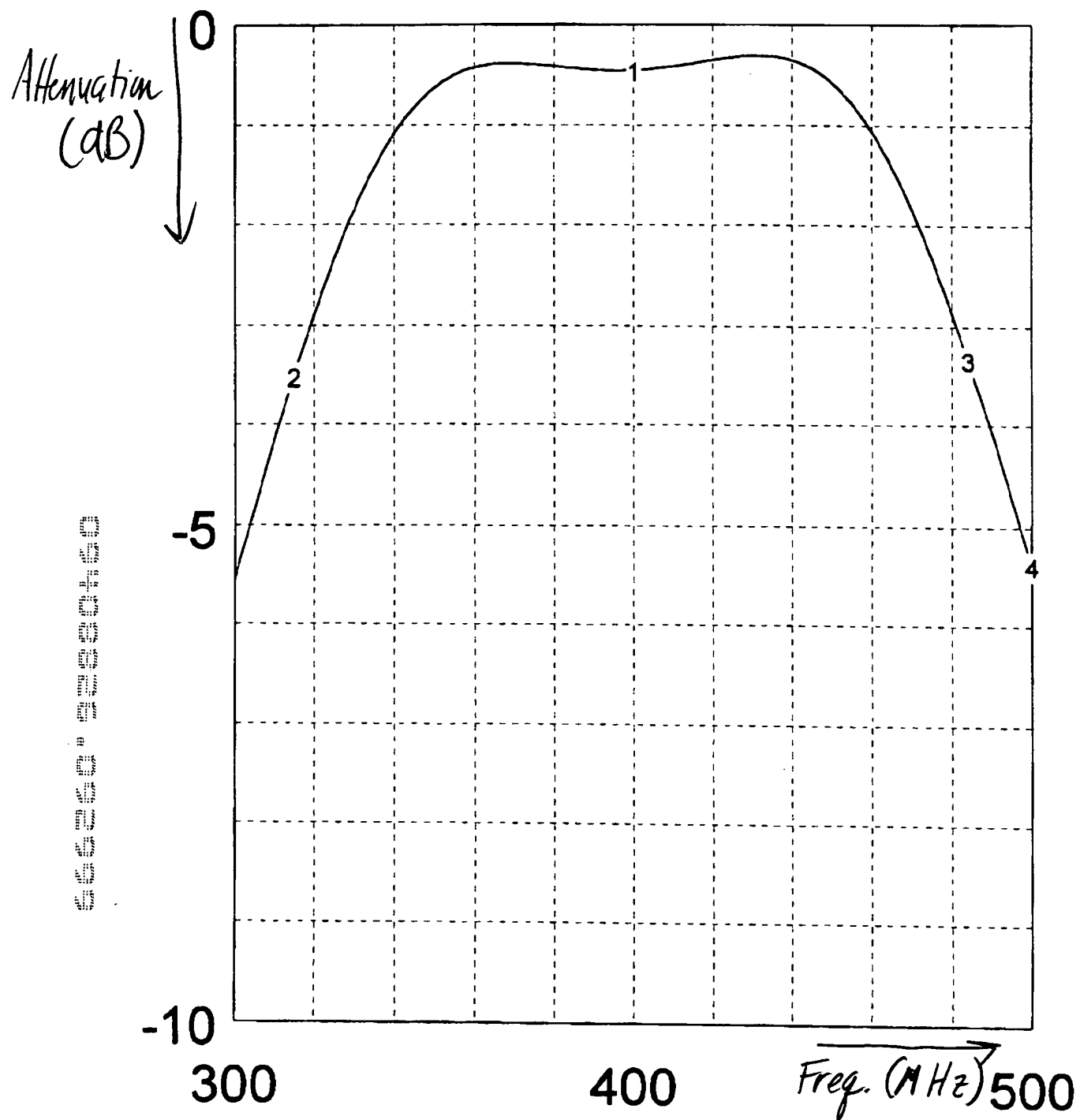


Fig. 21



400	199	601	700
-0.450828	-18.845	-16.7906	-24.0876

Fig. 22a



400	315	484	500
-0.450828	-3.51348	-3.32686	-5.3712

Fig. 22b

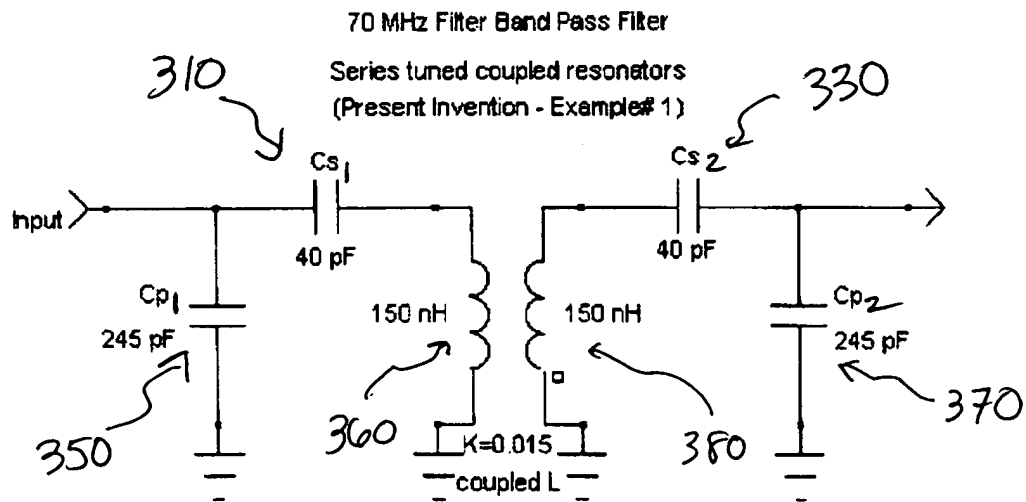
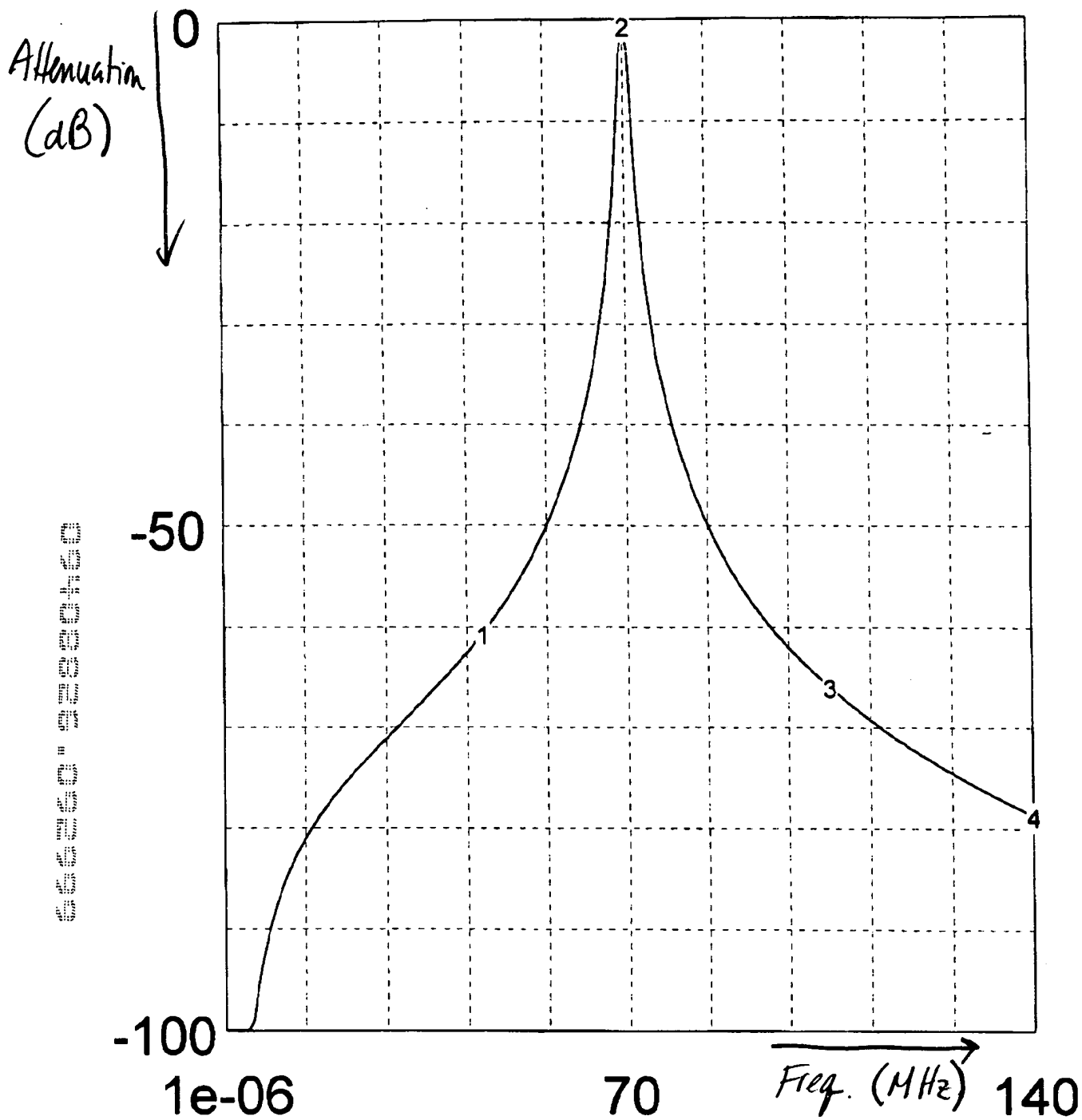
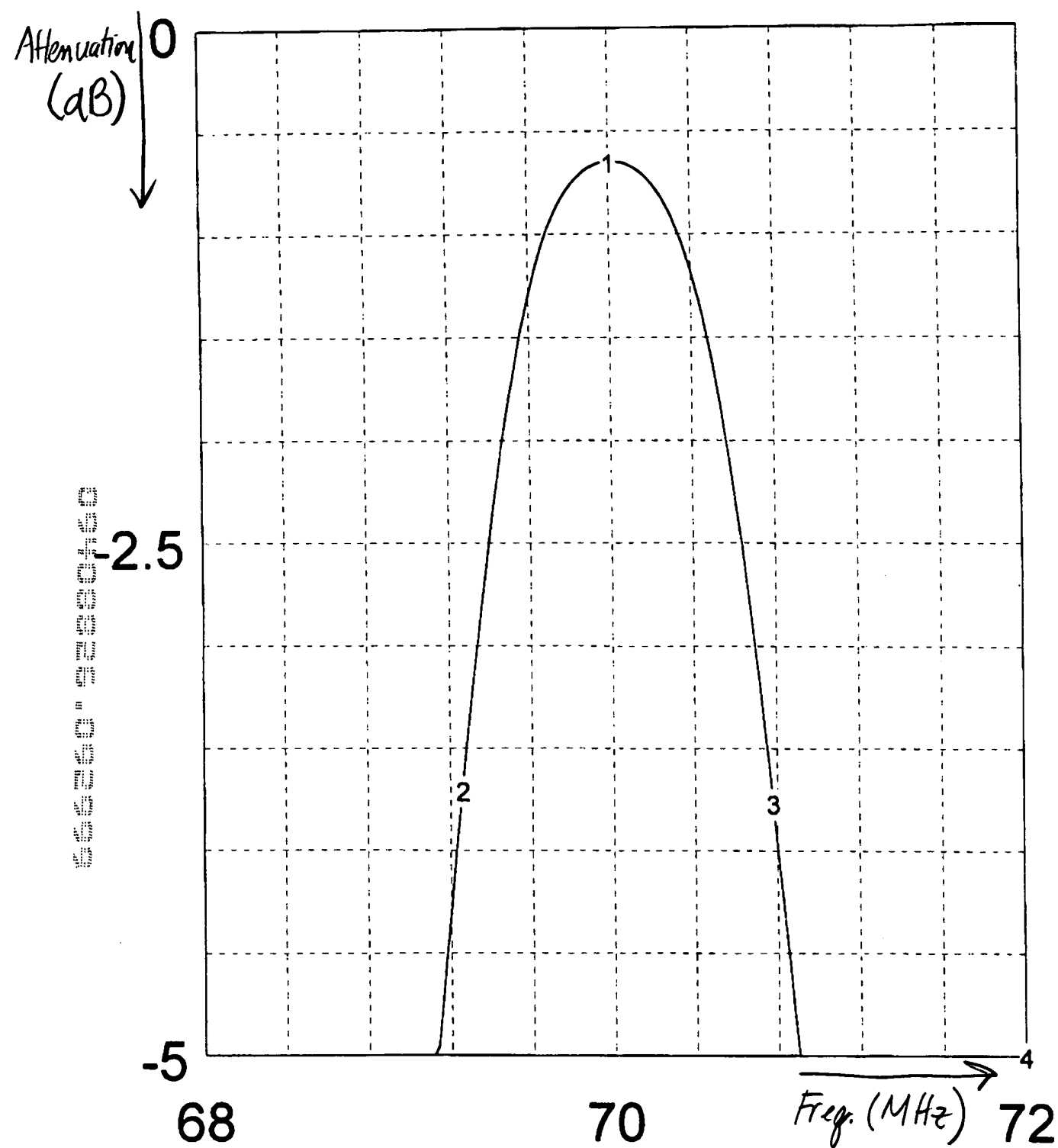


Fig. 24



44.8	70	105	140
-60.6209	-0.648476	-66.0358	-78.7293

Fig. 25a



70	69.26	70.78	72
-0.648476	-3.70701	-3.76667	-16.2641

400 MHz Filter Band Pass Filter

Series tuned coupled resonators
(Present Invention - Example# 2)

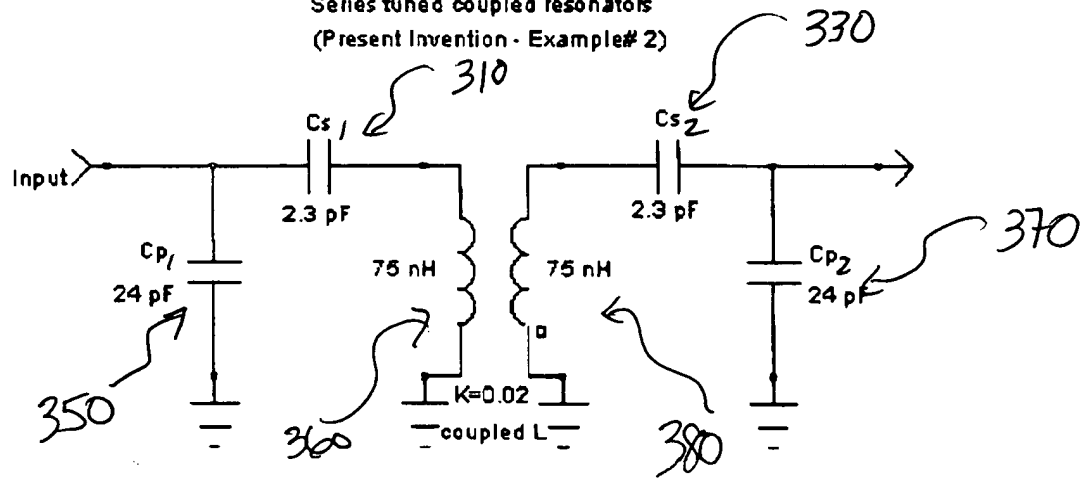
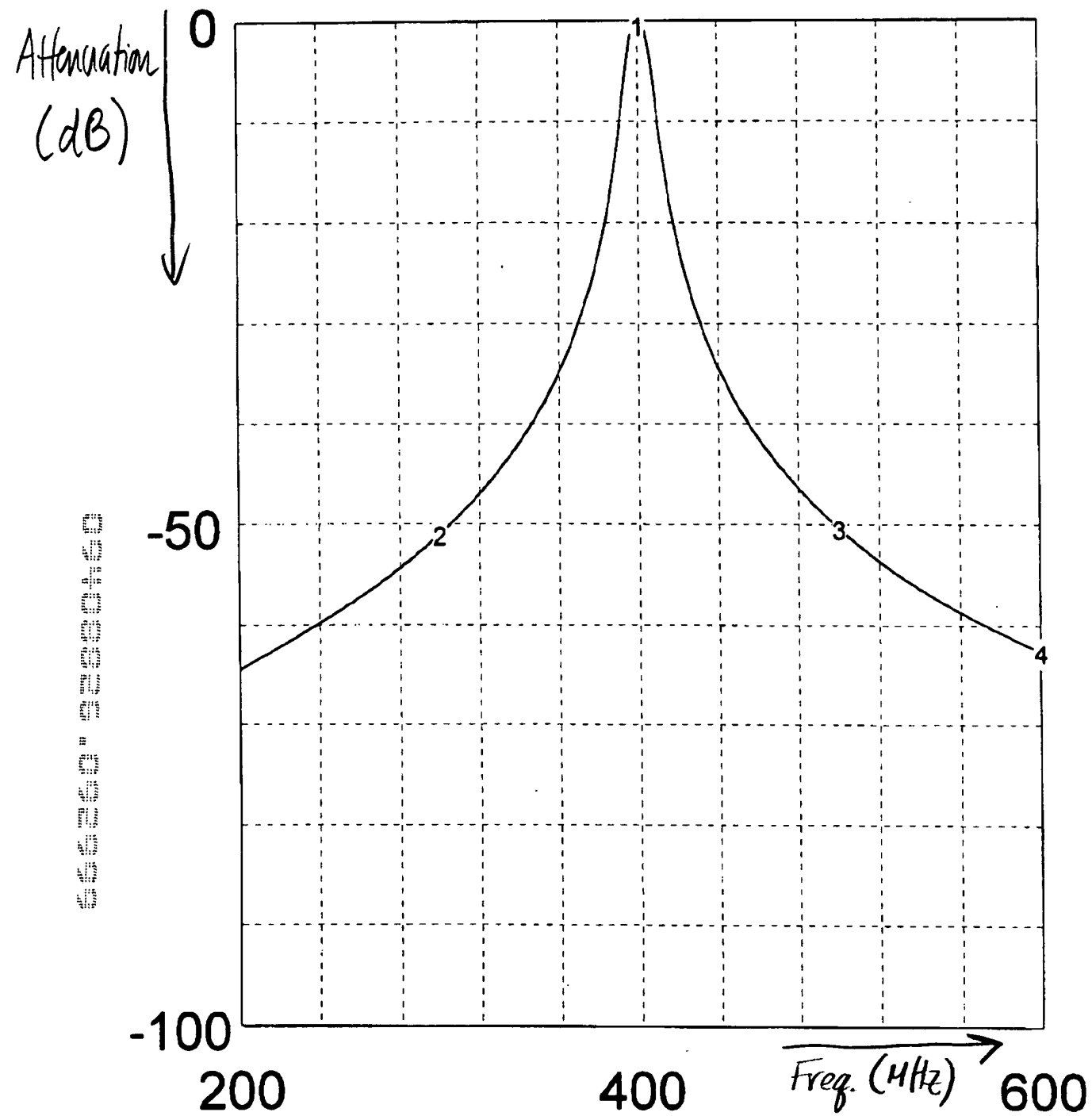
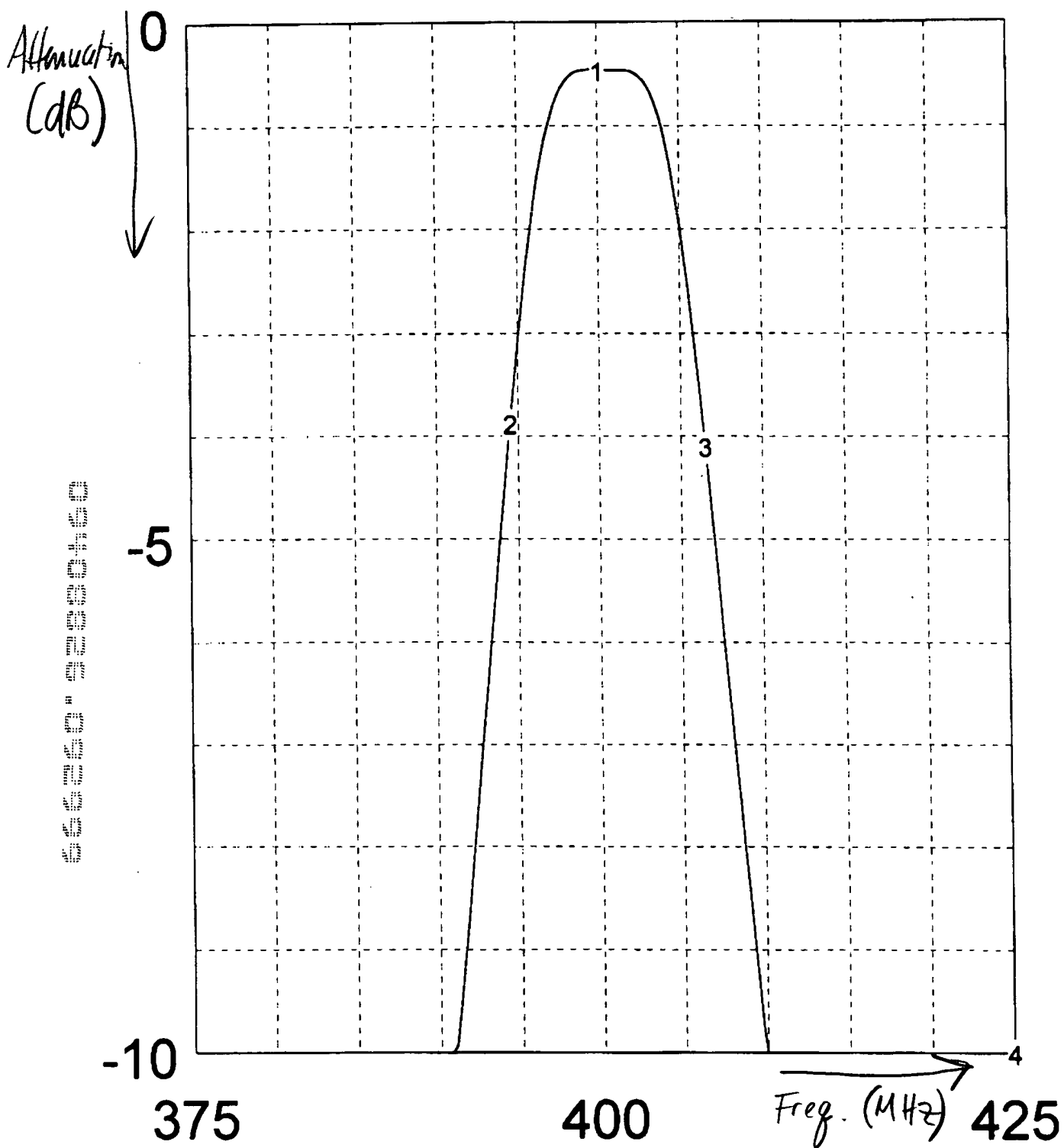


Fig. 26



400	300	500	600
-0.459122	-51.0187	-50.4078	-62.6643

Fig. 27a



400	394.5	406.5	425
-0.459122	-3.86683	-4.08966	-26.0854

Fig. 27b

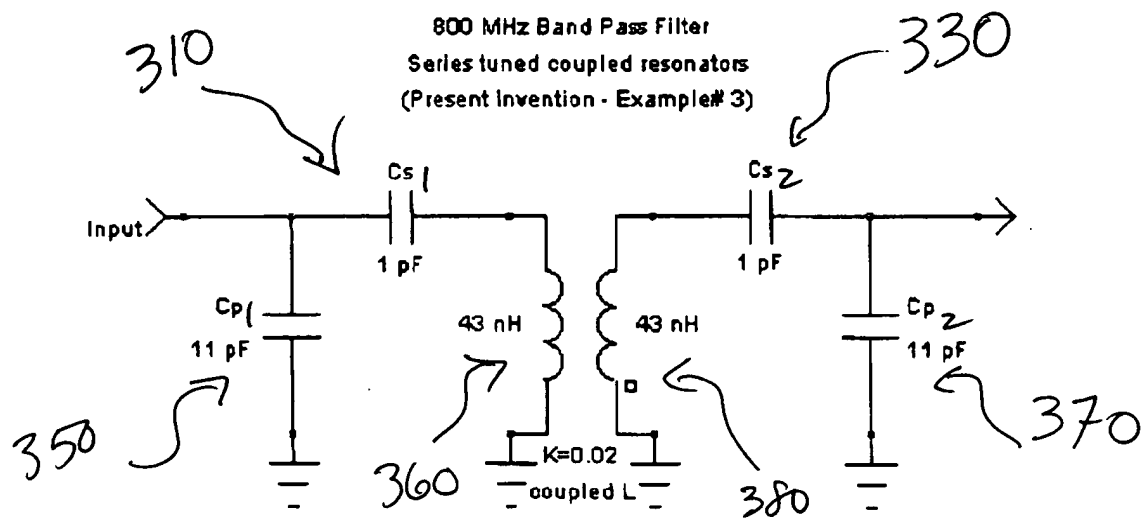


Fig. 28

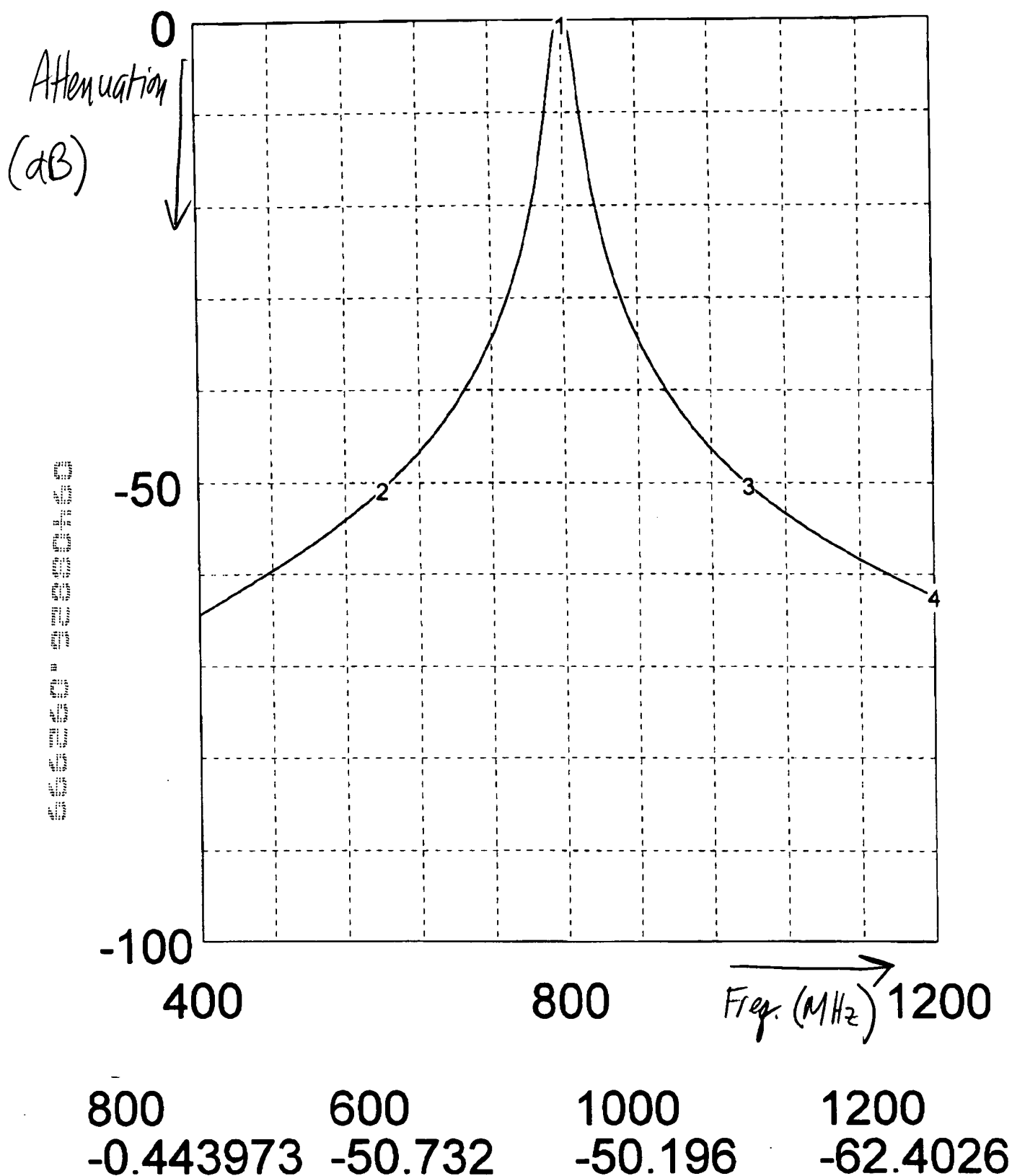
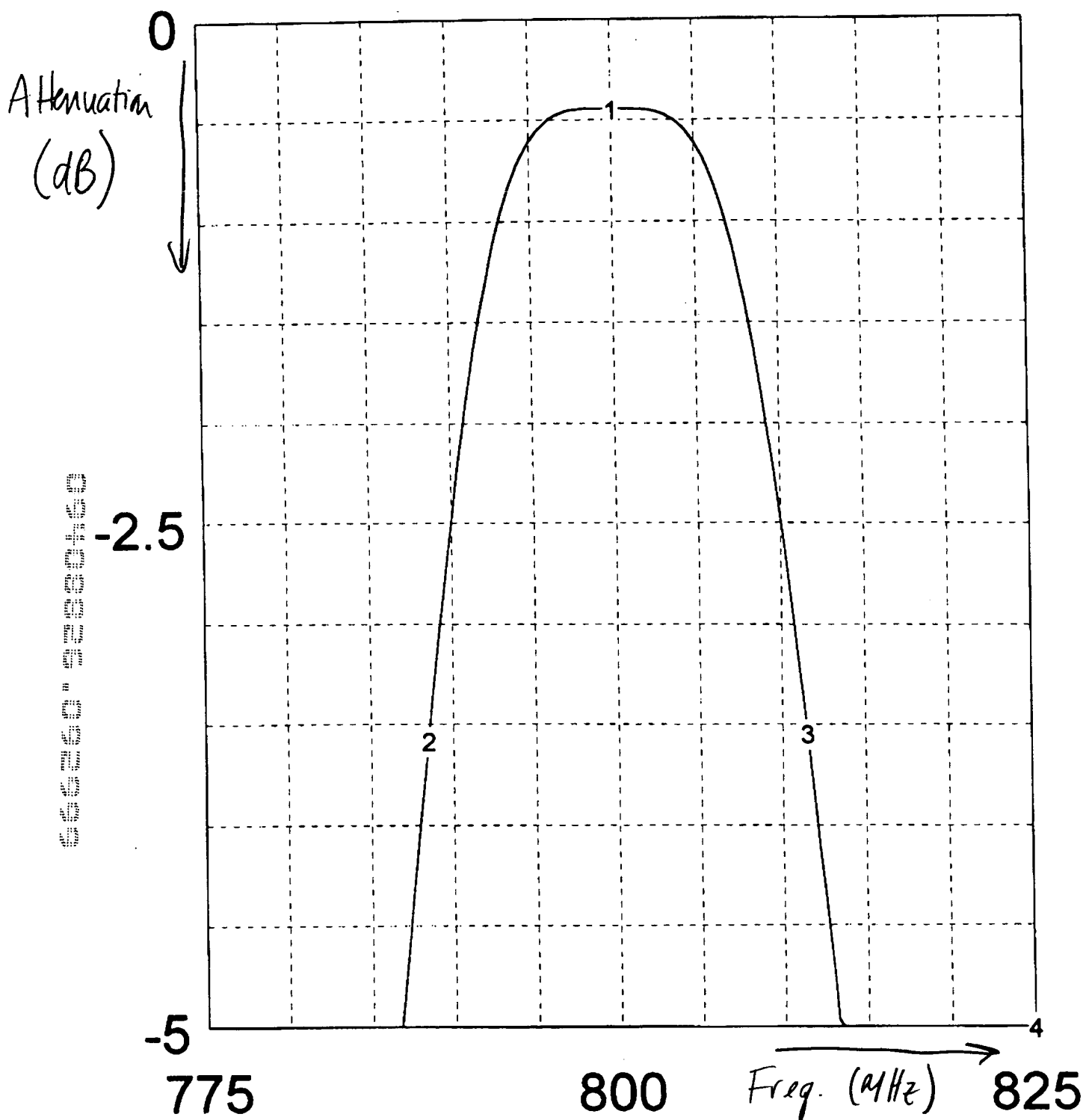


Fig. 29a



800	788.5	811.5	825
-0.443973	-3.57842	-3.54287	-14.2697

Fig. 296

Equivalent Inductance of Micro-Strip transmission lines used in example filters:					
Dielectric constant = 4.65; Height = 1.5 mm; Copper thickness: 0.018 mm					
Filter Example #	Filter Center Frequency (MHz)	Length of uStrip line (mm)	Width of uStrip line (mm)	Percentage of wave-length (%)	Equivalent Inductance of uStrip line (nH)
4	70	12.25	1.5	0.6	6.1
5	400	4	1	1.1	2.4
6	800	3.9	3	2.3	1.3
7	400	5.35	3	1.5	1.8
8 (multiple microstrip lines connected in parallel)	400	5.5	3 lines connected in parallel, each 2 mm wide	1.6	(2.4 nH each) 0.72nH total (see note)
9	400	29.4	2	8.5	14
10 (multiple microstrip lines connected in parallel)	400	5.5	3 lines connected in parallel, each 2 mm wide	1.6	(2.4 nH each) 0.72nH total (see note)
Note: Adding more microstrip lines connected in parallel (multistrip lines), very low inductance values, in the order of 0.5 nH, of high accuracy and repeatability are achievable. Considering the achievable tolerances in manufacturing (length and width of the lines), a tolerance of +/- 2% of the inductance value of the multistrip lines is possible.					

Fig. 30

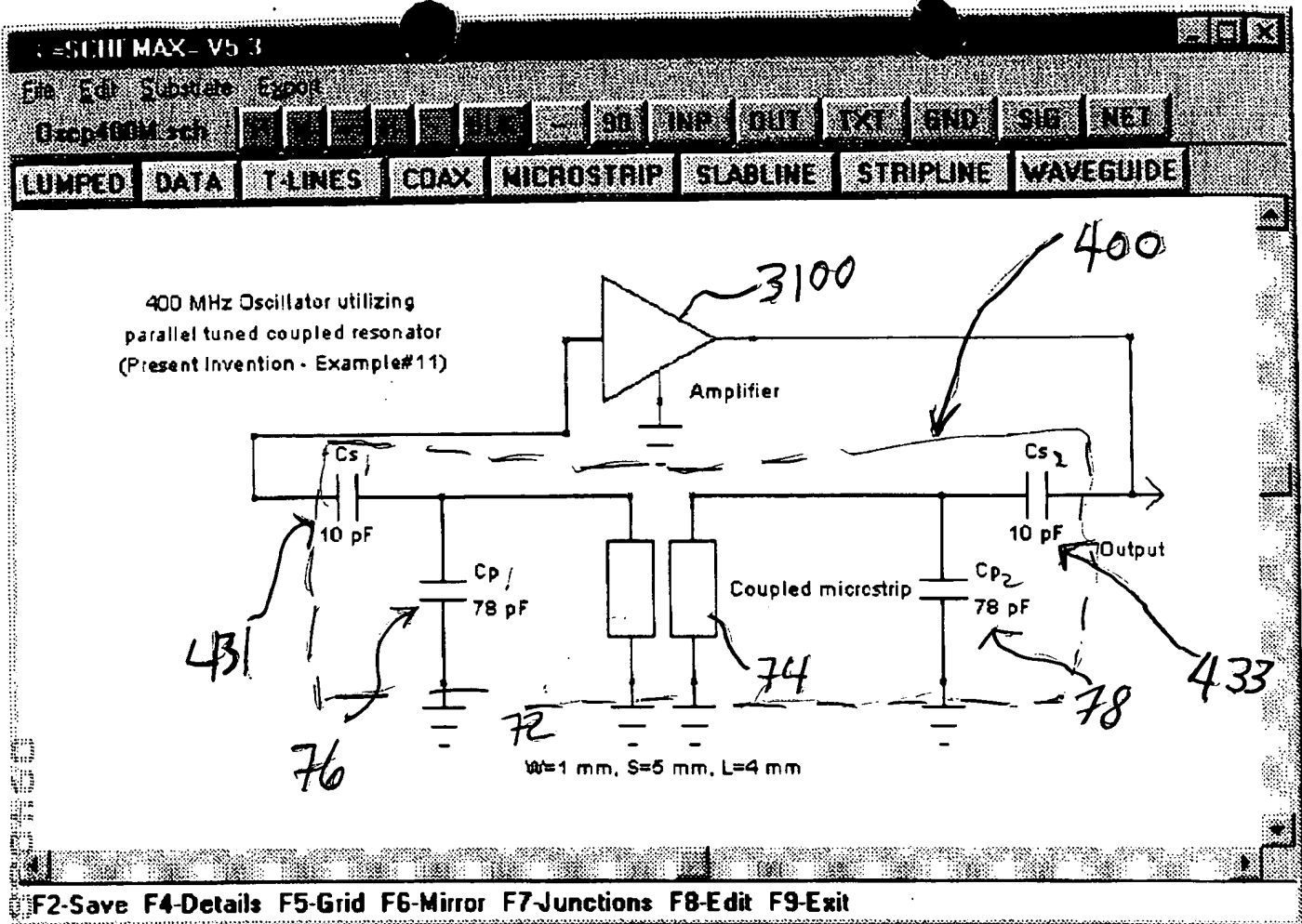


Fig. 31

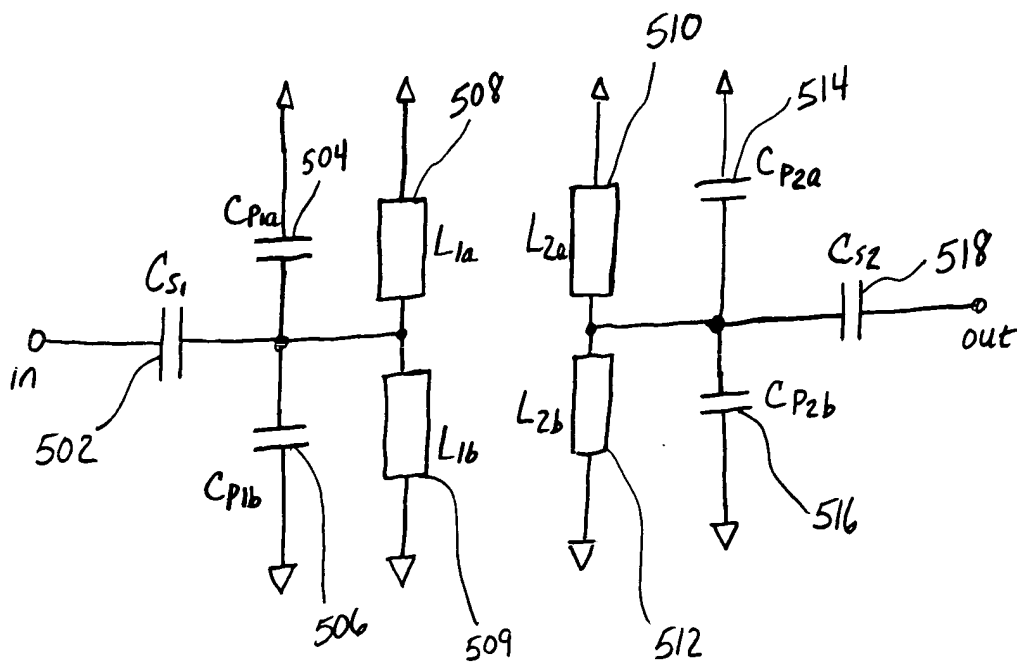


Fig. 32a

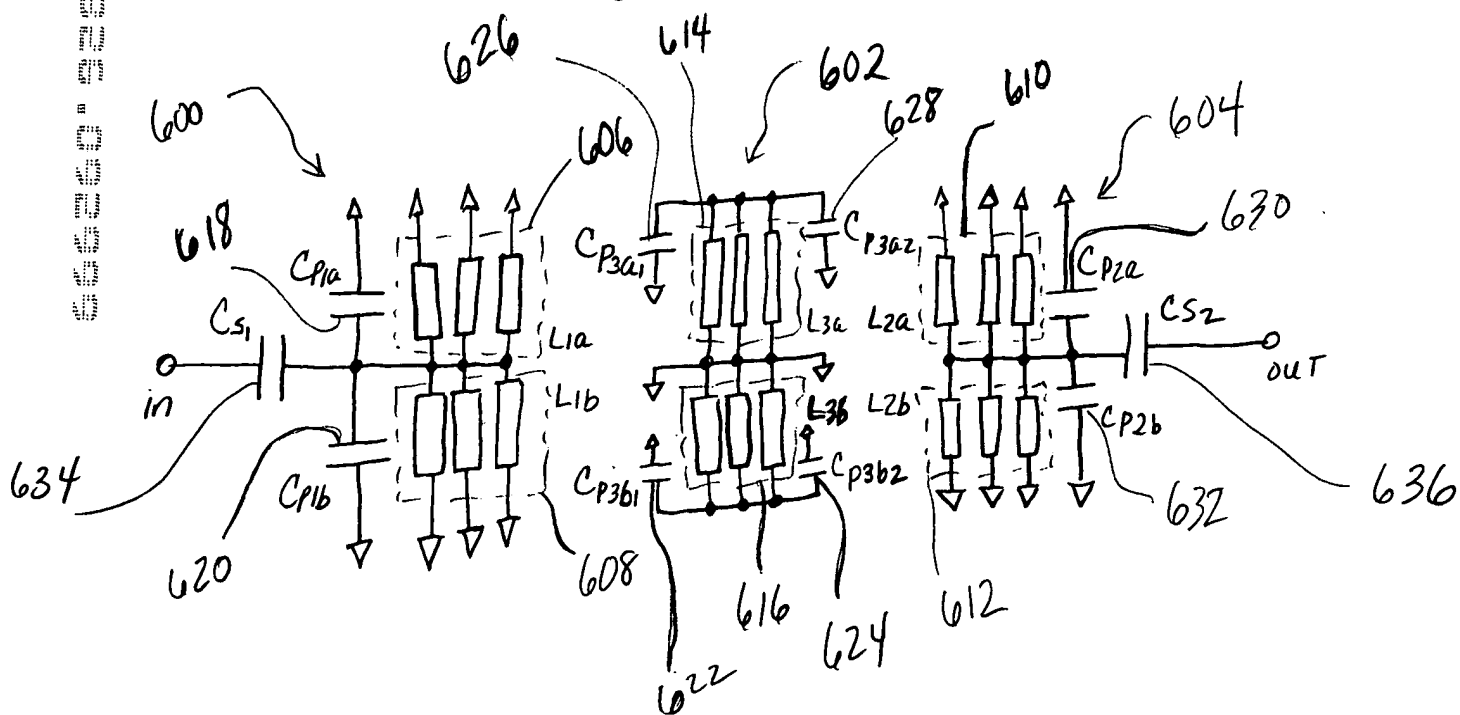


Fig. 32b

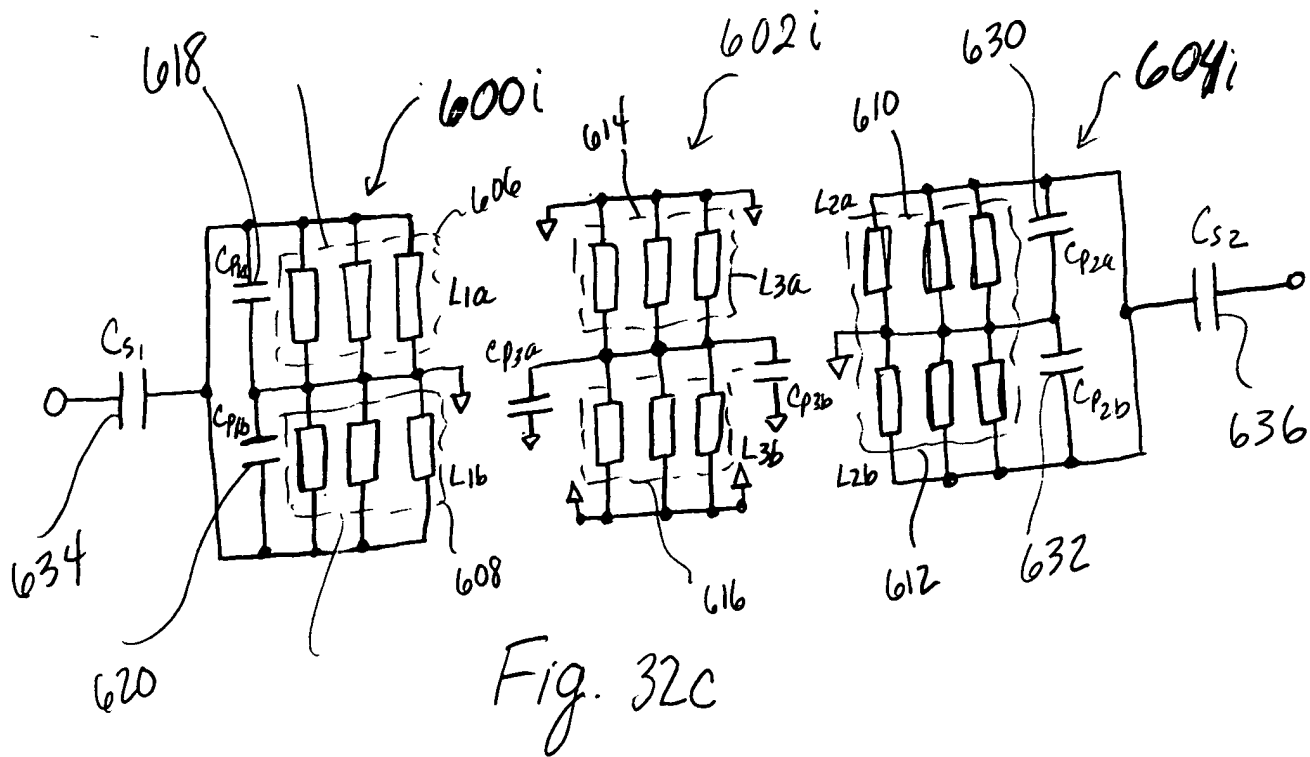
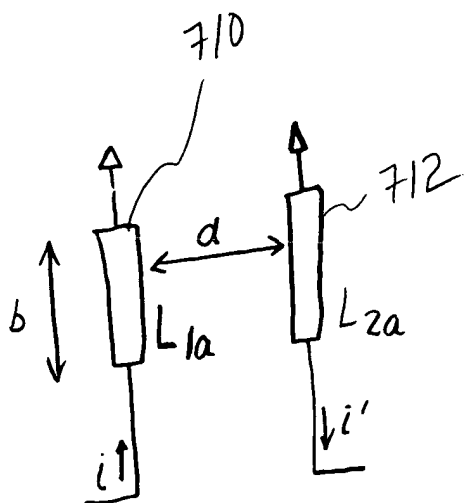
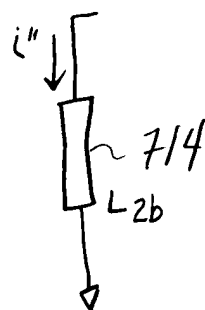
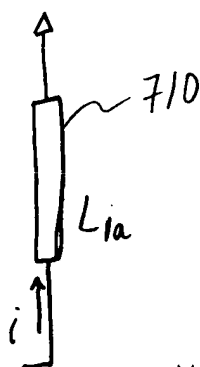


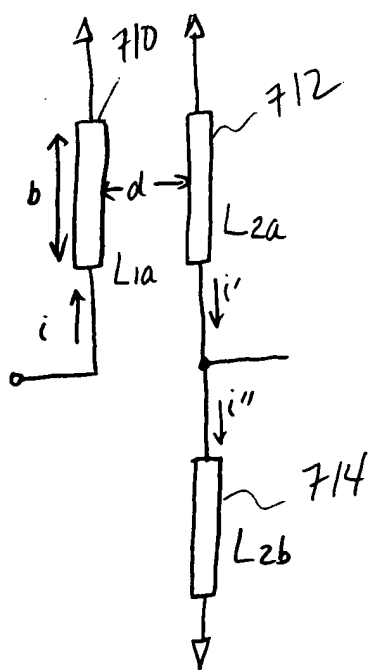
Fig. 32c



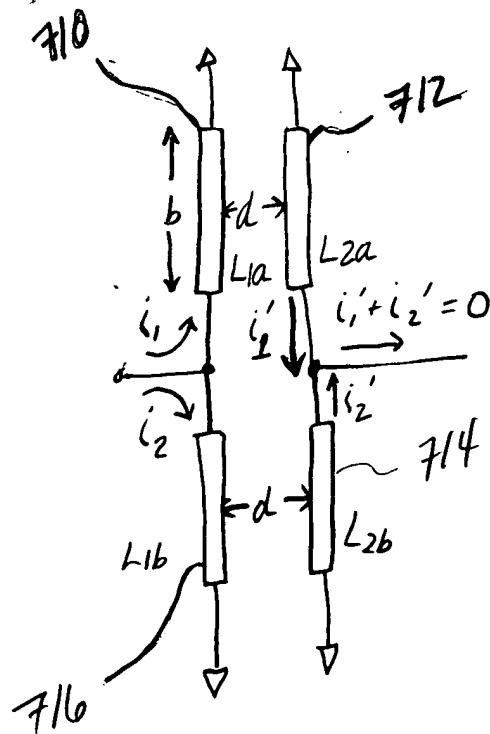
(a)



(b)



(c)



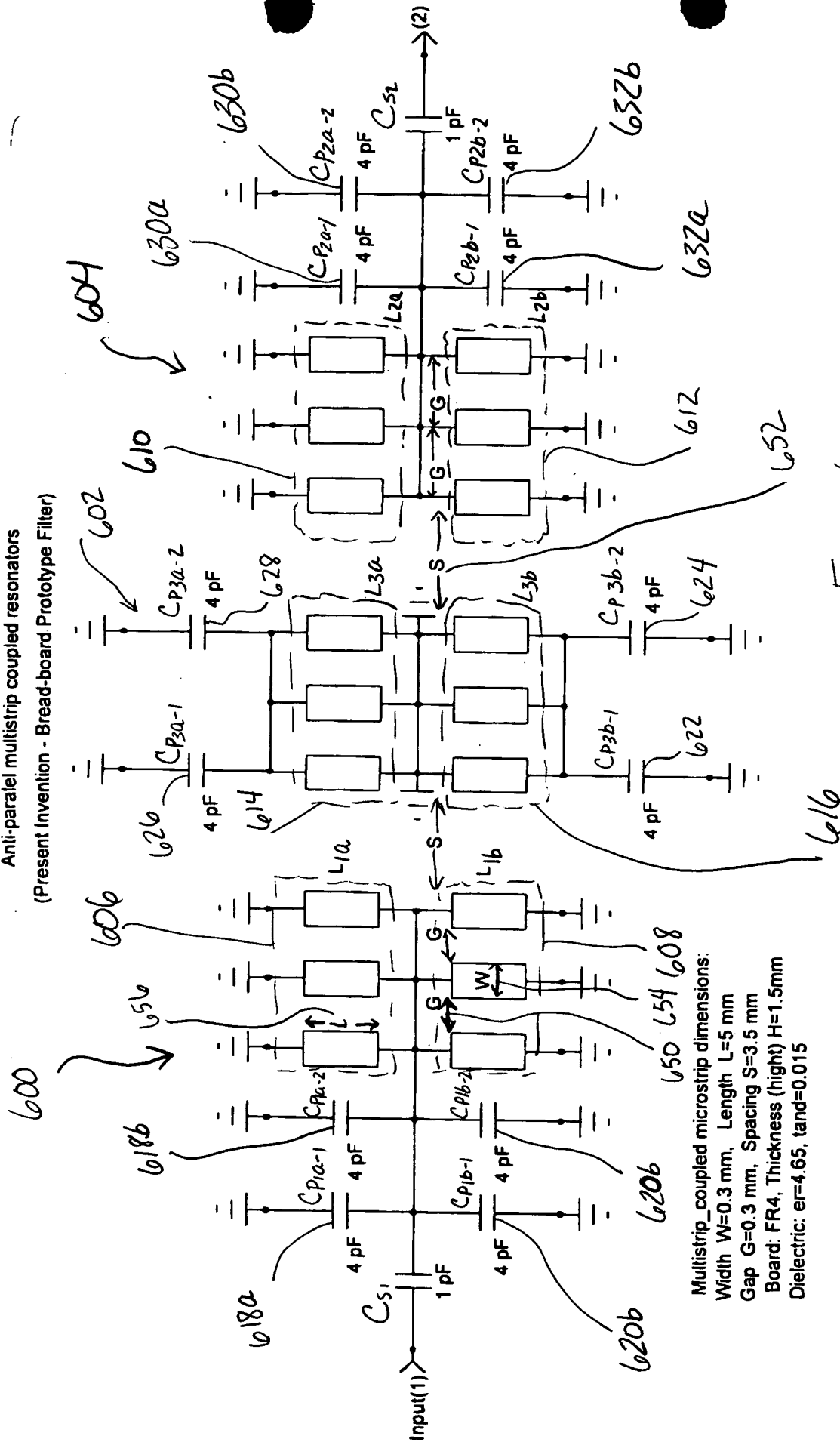
(d)

Fig. 33

Band Pass Filter: $f_c = 1015.75 \text{ MHz}$, BW = 30 MHz

Anti-parallel multistrip coupled resonators

(Present Invention - Bread-board Prototype Filter)



CH2 S21 log MAG 10 dB/ REF 0 dB 27 Aug 1998 10:26:50
1: -7.8898 dB

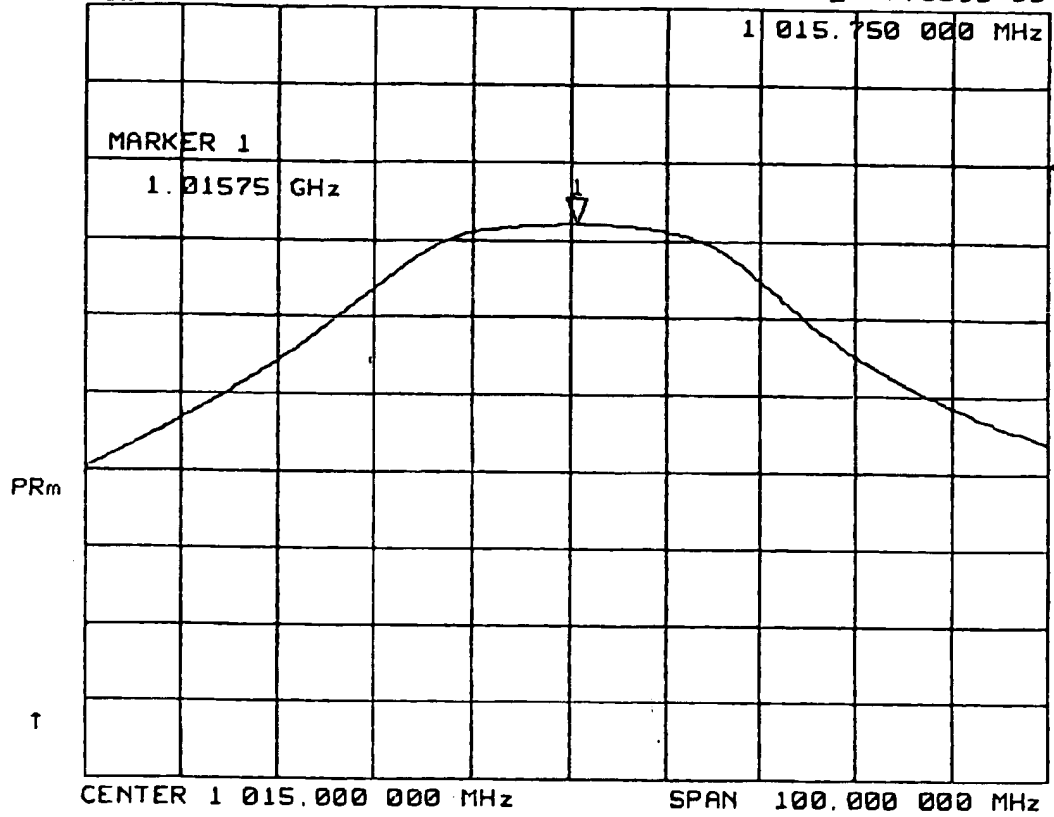


Fig. 34b

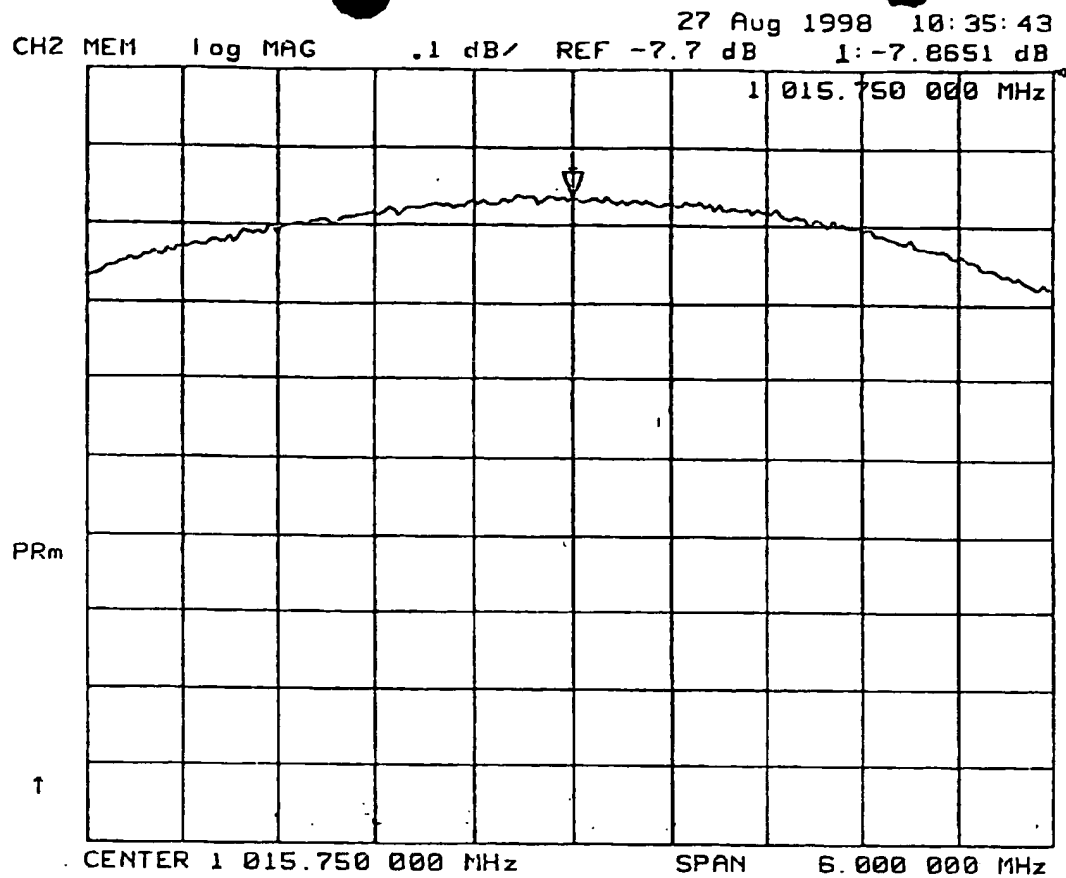


Fig. 34c

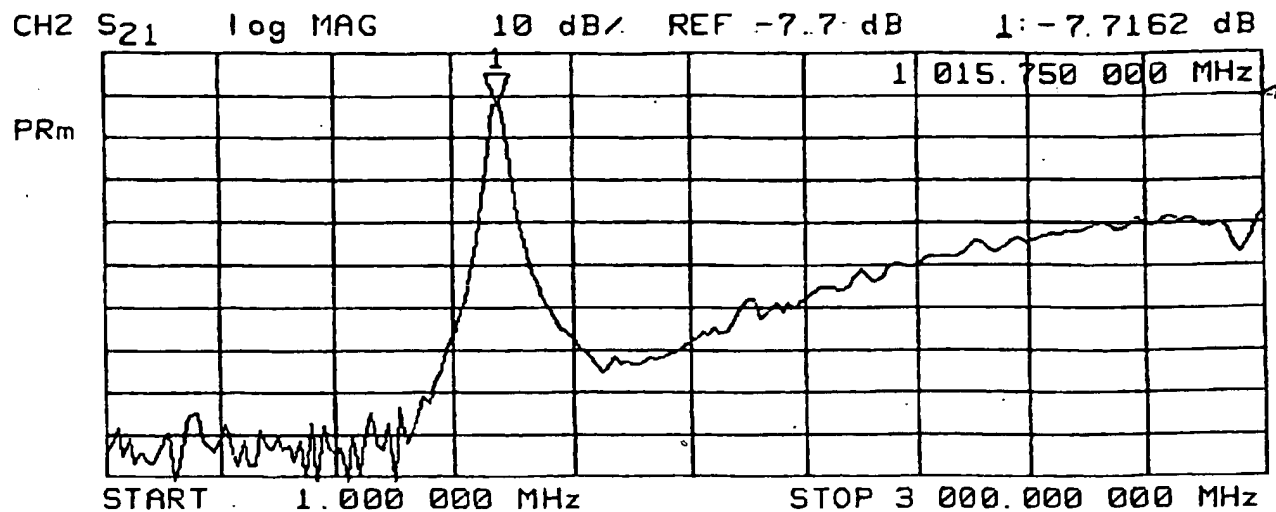


Fig. 34d

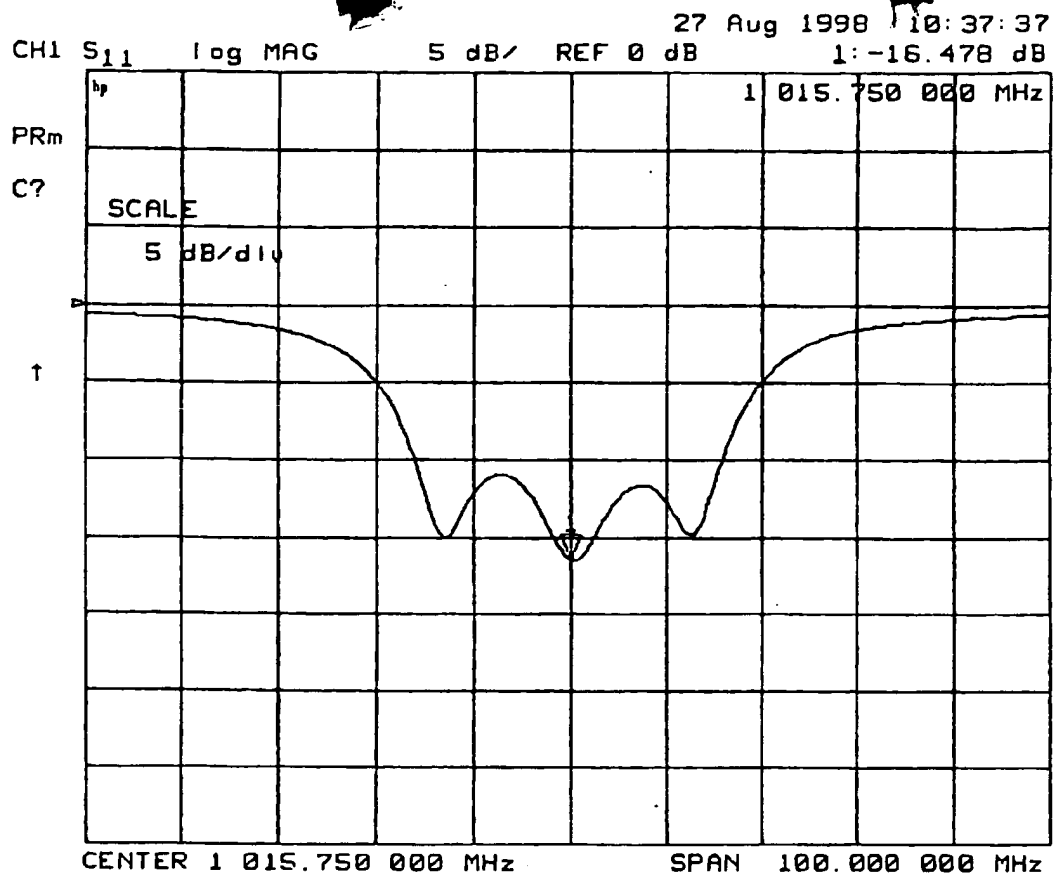


Fig. 34e